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PROCEEDINGS.

REGULAR MEETING, January 6, 1891.

President Abert in the chair.

The minutes of the December meeting read and approved.

Miss Lida J. Brown, Dr. Chas. T. Phythian, Bert W. Williamson and S. Marcus Fechheimer were elected active members.

The minutes of the Executive Board for November were read.

The resignations of Miss Ida Murdoch and Dr. Mary E. Osborn were read and accepted.

The death of Dr. John Davis was announced.

Mr. Davis L. James read by title two papers, one on North American Fungi, by A. P. Morgan; the other entitled a Manual of the Paleontology of the Cincinnati Group, by Jos. F. James.

Dr. Henshall read by title a paper on the Birds of Warren County, Ohio, by Raymond W. Smith.

Col. J. W. Abert, the President, then addressed the Society on (1) The Trend of Mountain Chains; (2) The Torsion of the Earth; (3) The Theory of Hot Springs.

Mr. Skinner asked whether the diurnal variation of the magnetic needle was not apparent rather than real, which was discussed by himself and Mr. Latham Anderson.

A photograph of a leaf insect from Central America, donated by Mr. T. H. Aldrich, was exhibited.

Adjourned.

REGULAR MEETING, February 3, 1891.

President Abert in the chair.

Minutes of January meeting read and approved.

Mrs. James LeBoutillier, Sr., Mrs. Mamie Hall, George Gregg Johnston, Alexander Starbuck and James Brown Kemper were proposed for active membership.

On motion of Mr. A. D. Smith, the rules were suspended and Mrs. Mamie Hall was elected an active member.

On motion of Mr. J. Ralston Skinner, the attention of the Photographic Section was to be called, by the Secretary, to the spilling of water on the floor of the dark room and the danger of the same to the ceiling of the auditorium.

The minutes of the Executive Board for December were read.

The resignations of Drs. A. Hoeltge and A. C. Kemper were read and accepted.

The Secretary read by title a paper entitled: "Notes on the Batrachians and Reptiles of Vigo County, Indiana, by Prof. W. S. Blatchley.

Mr. Chas. Dury exhibited two specimens of Mot-mots from Central America, and made some interesting remarks concerning the habits of the species in denuding and mutilating their tail feathers, and of their peculiar and anomalous habit of living in holes in the ground.

Mr. David W. Miller then read a paper, "On the influence of Ocean Currents in the formation of Continents," which commanded the close attention of those assembled.

Mr. Chas. Dury read by title a paper by Mr. A. W. Butler, entitled, "Contribution to Indiana Herpetology No. 3."

Adjourned.

REGULAR MEETING, March 3, 1891.

A quorum not being present, owing to the inclemency of the weather, an informal meeting was held to pass resolutions

respecting the memory of Mr. Chas. F. Low and Mr. S. E. Wright, two members of the Society recently deceased.

The following members were present: Messrs. Skinner, Langdon, James, Tally, Peck and Henshall.

On motion, Mr. J. R. Skinner took the chair, and stated the object of the meeting.

The following committees were appointed: On the death of Mr. C. F. Low, Messrs. Langdon, James and Talley; on the death of Mr S. E. Wright, Messrs. James, Talley and Langdon.

The following resolutions were adopted, subject to approval of next regular Society meeting:

Report on Mr. Low.

Mr. Charles F. Low, who was favorably and widely known among scientists for his researches in the departments of American history, archæology and ethnology, died at his home in Madisonville, Ohio, February 26, 1891, after a short illness of acute pneumonia, at the age of fifty-three.

Mr. Low was born at Providence, R. I., April 22, 1837, and often referred to his early life as a boy along the sea coast. In 1856 he came west to Athens, Ohio, and finally located at Chillicothe during the same year, where he became connected with the M. & C., now B. & O. S. W. R. R. Co., with which company he remained during all its various changes of name and ownership, up to the time of his last illness—a continuous period of thirty-four years' service, during which time he rose from a clerk in the office to the position of Auditor, and finally Secretary-in-Chief. In 1858 he married Miss Mary Augusta McClintick, of Chillicothe, who, with eight children, five sons and three daughters, survives him.

Deceased was a scholarly man, well read in the subjects above mentioned, and especially noted for his effective labors, both in the field and with the pen, in connection with the development and exploration of the "Madisonville Prehistoric Cemetery," situated on the Ferris farm, near the town mentioned. The publications of that work, mainly the product of his pen, are to be found in the Journal of this Society for 1880. Mr. Low became a member of this Society in 1878,

and served on its executive board for two years. While his residence out of town precluded frequent attendance at the evening meetings, he was prompt and regular in his executive board duties, and numbered among the active members of this Society many warm and appreciative friends. He was also one of the founders of the Literary and Scientific Society of Madisonville, the body which inaugurated and carried on successfully about two years, unaided, the original explorations above referred to.

In December, 1890, he, in company with his wife, visited Southern California for a period of recreation, and while there made extensive collections and investigations into the geology, conchology and archæology of that section. Shortly after his return he was seized with his fatal illness.

In his death this Society loses a valued member and contributor to its journal; his family a loving and indulgent husband and father; his personal associates a warm and cultured friend, and the community a most honorable and useful citizen,

Respectfully,

F. W. Langdon,
Davis L. James,
Geo. L. Talley,
Committee.

Report on Mr. S. E. Wright.

In the death of Mr. Smithson E. Wright, the Society has lost one of its most trusted and valued members. Mr. Wright became a member of the Society in 1872, a year or two after its organization, and was elected trustee and manager of the funds of the Society, as well as its treasurer. He filled these positions to the satisfaction and welfare of the organization for the period of eighteen years, when, because of the infirmities naturally attending his advanced age, he felt it necessary to decline the position he had so worthily and acceptably filled. The sympathy of the Society is respectfully tendered to his family in their bereavement.

Davis L. James,
Geo. W. Talley,
F. W. Langdon,
Committee.

The meeting then adjourned

NORTH AMERICAN FUNGI.

By A. P. Morgan.

Fourth Paper.

(*Continued from Vol. XII., p. 172.*)

(Read January 6, 1891.)

THE GASTROMYCETES.

Genus IX.—Lycoperdon, Tourn.

Mycelium fibrous, rooting from the base. Peridium small, globose, obovoid or turbinate, with a more or less thickened base; cortex a subpersistent coat of soft spines, scales, warts, or granules; inner peridium thin, membranaceous becoming papyraceous, dehiscent by a regular apical mouth. Subgleba cellulose, continuous above with the capillitium, rarely definitely limited; capillitium originating from the inner surface of the peridium and from the subgleba; the threads long, slender, simple or branched, the thickness of the main stem commonly about equal to the diameter of the spores, the branches tapering; spores small, globose rarely oval or elliptic, even or warted, mostly sessile or with only a minute pedicel, but usually accompanied by the deciduous sterigmata. Plate I, Fig. 1.

Puffballs of small size, growing on the ground in fields and woods; only two or three species grow on old trunks of trees and one grows on mosses. The peridium is usually furnished with a distinct cellulose base underneath the gleba; in a few species the subgleba is nearly or quite obsolete. The threads of the capillitium usually appear in two distinct sets, first those which grow inward from the wall of the peridium, secondly those that arise from the subgleba; the latter are often much elongated toward the center and present a thick tuft rising toward the apex of the peridium, which has been termed the columella. The capillitium threads are mostly colored and are thicker than the fine hyaline densely inter-

woven hyphae which compose the wall of the peridium; but they seem to me generally branches of the latter and hence fixed at one extremity and free at the other. Possibly free threads are to be found, at least in some of the species, among those which proceed from the subgleba; but if so, they are generally too long and involved to be easily segregated.

TABLE OF SPECIES OF LYCOPERDON.

§1. Purple-Spored Series. Mature spores purplish brown.

a. Cortex consisting of very long convergent spines 1, 2.

b. Cortex composed of long slender convergent spines 3, 4.

c. Cortex composed of minute spinules 5, 6, 7.

d. Cortex a furfuraceous persistent coat 8, 9, 10.

e. Cortex a smooth continuous layer, becoming areolate 11, 12.

§2. Olive-Spored Series. Mature spores usually brownish-olivaceous.

A. Peridium obovoid or turbinate, the subgleba well developed.

f. Cortex of long spines mingled with shorter ones, the former at length fall away, leaving a reticulate surface to the inner peridium 13, 14.

g. Cortex of stout spines which fall away and leave a tomentose or furfuraceous surface to the inner peridium 15, 16.

h. Cortex of long spines, curved and convergent at the apex, which fall away and leave a smooth surface to the inner peridium 17, 18, 19, 20.

i. Cortex of minute spinules and granules or furfuraceous scales. Terrestrial. 21, 22, 23.

k. Cortex of minute spinules, scales or granules. Lignatile 24, 25.

B. Peridium very small, globose, the subgleba nearly obsolete.

l. Cortex a thin coat of minute spinules, scales or granules 26–31.

§1. PURPLE-SPORED SERIES. Mass of spores and capillitium immediately after deliquescence, usually olivaceous, then changing to violet or brownish-purple, and finally to purplish-brown; the threads branched, rarely simple, the main stem with a thickness about equal to the diameter of the spores, the branches long, slender and tapering, bright purplish-brown in color by transmitted light; the spores globose, distinctly warted, mostly sessile, but always accompanied by the long hyaline sterigmata, which persist along with them after deliquescence, sometimes some of them pedicellate; when fully matured dark purplish-brown in color and opaque.

a. Cortex consisting of very long convergent spines.

1. L. ECHINATUM. Pers. Peridium broadly obovoid, sometimes much depressed, usually with a narrow short and pointed base; mycelium of long, slender white fibers. Cortex composed of very long brown spines, converging and often coherent at the apex, with minute scurfy spinules intervening; the long spines at length fall away, at least from the upper part of the peridium, leaving the pale brown inner peridium ornamented with an elegant net-work of dark brown reticulations; these finally disappear, leaving behind a smooth pale-brown shining surface. Subgleba occupying about a third part of the peridium, sometimes quite shallow; mass of spores and capillitium olivaceous, then violet to brownish-purple; the threads much branched, the main stem nearly as thick as the spores, the branches long, slender and tapering; spores globose, distinctly warted, 5–6 mic. in diameter. Plate I, Fig. 5.

Growing on the old leaves in dense woods. New York, *Peck;* Pennsylvania, *Schweinitz;* Ohio, *Morgan;* Wisconsin, *Trelease.* Peridium ¾–1½ inches in diameter, scarcely more than an inch in height. My specimens, which are abundant, agree exactly with European specimens of *L. echinatuam*, Pers; furthermore *L. constellatum*, Fr., does not appear to be separable as a distinct species.

2. L. PULCHERRIMUM, B. & C. Peridium usually obovoid, sometimes subturbinate, with a short stout base; the mycelium forming a thick cord-like root. Cortex consisting of very long

white spines, converging and often coherent at the apex; the spines at length fall away from the upper part of the peridium, leaving the inner peridium with a smooth purplish-brown shining surface, sometimes faintly reticulated. Subgleba occupying about a third part of the peridium; mass of spores and capillitium at first olivaceous, then brownish-purple; the threads much branched, the main stem thicker than the spores, the branches long, slender and tapering; spores globose, minutely warted, 4.5–5.5 mic. in diameter. Plate I, Fig. 3.

Growing in low grounds, in fields and woods. New England, *Frost;* Pennsylvania, *Michener;* Maryland, *James;* Ohio, *Morgan;* Wisconsin, *Trelease;* Iowa, *McBride;* Nebraska, *Webber;* Kansas, *Cragin.* Peridium 1–2½ inches in diameter and 1–2 inches in height. I have accepted this name of the species on the assurance of Prof. Trelease, for the original description of Berkeley is certainly quite inapplicable. It has hitherto been generally known as *L. Frostii,* Peck. *L. rima-spinorum,* Cragin, does not appear to differ essentially. *L. asperrimum,* W. & C., of the Pacific Coast Catalogue, is quite likely another name applied to this species; and if this is truly the species of the Fungi Angolenses it is a still older name than the one here adopted. The fresh specimens of this plant have a strong and not unpleasant fragrance.

b. Cortex composed of long, slender convergent spines.

3. L. HIRTUM, Mart. Peridium broadly turbinate, depressed above, contracted below into a short, thick, tapering or pointed base, with a cord-like root. Cortex a dense coat of soft spines, long, slender and convergent above, becoming shorter downward, gray or brownish in color; these finally fall away, leaving the inner peridium with a brown or purplish-brown smooth, shining surface. Subgleba occupying from one-third to one-half of the peridium; mass of spores and capillitium olivaceous, then brownish-purple; the threads branched, the main stem about as thick as the spores, with slender, tapering branches; spores globose, distinctly warted, 5–6 mic. in diameter. Plate I, Fig. 2.

Growing on the ground in woods. Peridium 1–2½ inches in diameter and 1½–2 inches in height. This species in this

country heretofore has been included with *L. atropurpureum.* I have followed Mr. Massee in keeping them separate. This is perhaps *L. bicolor*, W. & C., of the Pacific Coast Catalogue.

4. L. ATROPURPUREUM, Vitt. Peridium subglobose, often irregular, plicate and lacunose underneath, with a fibrous mycelium. Cortex of slender spines or hairs, long and convergent above, becoming shorter below, gray or brownish above and whitish underneath; these at length fall away, leaving a smooth, shining, pale-brown or purplish surface to the inner peridium. Subgleba broad and shallow, scarcely occupying a third part of the peridium, sometimes nearly obsolete; mass of spores and capillitium olivaceous, then brownish-purple; the threads branched, the main stem about as thick as the spores, with long, slender, tapering branches; spores globose, distinctly warted, 5.5–6.5 mic. in diameter.

Growing on the ground in woods. New York, *Peck;* South Carolina, *Atkinson;* Ohio, *Morgan;* Wisconsin, *Trelease.* Peridium 1–2 inches in diameter. This is possibly the *L. umbrinum* of Schweinitz, N. A. Fungi.

c. Cortex composed of minute spinules.

5. L. CUPRICUM, Bon. Peridium obconic, depressed above and tapering downward, the base plicate, with a fibrous mycelium. Cortex gray or flesh-color, composed of minute spinules circularly arranged and convergent and coherent at the apex; these dry up, becoming dark purplish in color, and finally fall away from the smooth, shining, copper-colored surface of the inner peridium. Subgleba occupying nearly a third part of the peridium; mass of spores and capillitium, at length purplish brown; the threads branched, the main stem thinner than the spores, with long, tapering branches; spores globose, distinctly warted, 6–7 mic. in diameter.

Growing in sandy soil in woods. New Jersey, *Ellis.* Peridium about 1 inch in diameter and an inch or more in height. The microscopic features are given from specimens received from Mr. Ellis.

6. L. ASTEROSPERMUM, D. & M. Peridium obovoid or pyriform, the base short and pointed, with a slender fibrous mycelium. Cortex a thin coat of minute spinules with inter-

mingled granules, gray or brownish above, paler below; these dry up and are a long time persistent, but they finally fall away, leaving the inner peridium with a pale brown, smooth, shining surface. Subgleba obconical, occupying nearly a third part of the peridium; mass of spores and capillitium olivaceous, then brownish-purple; the threads about as thick as the spores, with slender tapering branches; spores globose, distinctly warted, 5.5–6.5 mic. in diameter.

Growing on the ground in open woods. Ohio, *Morgan;* Nebraska, *Webber.* Peridium 1–1½ inches in diameter. A very pretty species of regular form; its glossy cortex is quite persistent.

7. L. DELICATUM, Berk. Peridium subglobose, plicate underneath, with a fibrous mycelium. Cortex a thin coat of minute spinules and granules, gray or brownish above, whitish below, finally falling away from the smooth, shining, pale or brownish surface of the inner peridium. Subgleba very small or quite obsolete; mass of spores and capillitium olivaceous, then pale or purplish-brown; the threads rather thinner than the spores, with slender tapering branches; spores globose, distinctly warted, 5–6 mic. in diameter.

Growing on the ground. Pennsylvania, *Gentry.* Peridium 1–2 inches in diameter.

d. Cortex a furfuraceous persistent coat.

8. L. GLABELLUM, Peck. Peridium obovoid with a short pointed base or turbinate, with a narrow tapering base; the mycelium slender, fibrous. Cortex a soft delicate flocculose covering, white cream-color or yellow, which dries up at maturity to a thin furfuraceous persistent coat, scarcely abraded in occasional patches disclosing the pale, smooth, shining surface of the inner peridium. Subgleba occupying nearly a third part of the peridium; mass of spores and capillitium pale olivaceous, then pale brown or finally purplish-brown; the threads about as thick as the spores, with slender tapering branches; spores globose, distinctly warted. 5–6 mic. in diameter. Plate I, Fig. 7.

Growing on the ground in woods. New England, *Frost;* New York, *Peck;* Ohio, *Morgan;* Wisconsin, *Trelease.* Peridium 1–1½ inches in diameter and about the same in

height. A beautiful species, regular in form, soft to the touch and attractive in color.

9. L. ELONGATUM, Berk. Peridium globose above, contracted below into a stout thick base, more or less elongated and cylindric or tapering downward; mycelium composed of thick fibers. Cortex a loose flocculose white or yellowish coat, drying up into a mealy or furfuraceous persistent layer, which scarcely reveals the pale shining surface of the inner peridium. Subgleba occupying more than half the interior of the peridium; mass of spores and capillitium pale olivaceous, then pale brown or finally purplish; the threads much branched, the main stem much thicker than the spores, the branches tapering; spores globose, distinctly warted, 5.5–6.5 mic. in diameter.

Growing on the ground in damp woods. Ohio, *Morgan.* Peridium 1–2 inches in diameter and 2–3 inches in height, the base ¾–1 inch in thickness. In form it somewhat resembles *L. gemmatum*, but it has a cortex like that of *L. glabellum.* Perhaps Trelease's Figure 2, Plate IX, is referable to this species.

10. L. ELEGANS, Morg. n. sp. Peridium large, depressed globose, plicate underneath and sometimes with a narrow umboniform base, which is continuous with the thick root. Cortex at first flocculose, white or yellowish, drying up into a dense furfuraceous persistent coat, which becomes ochraceous or brownish in color, and sometimes obscurely areolate. Subgleba broad, convex above, occupying a third part or more of the peridium; mass of spores and capillitium, olivaceous, then pale-brown or finally purplish-brown; the threads much branched, the main stem thicker than the spores, the branches long and tapering; spores globose, distinctly warted, 5–6 mic. in diameter. Plate I, Fig. 4.

Growing on rich soil on the open prairie about Iowa City, Iowa, *Prof. T. H. McBride.* Peridium 1½–3 inches in diameter. In form and size this species somewhat resembles *Calvatia fragilis*, but the threads are arranged in two sets as in Lycoperdon; the cortex is similar to that of *L. glabellum;* the mycelium forms a remarkably thick root.

e. Cortex a smooth continuous layer, becoming areolate.

11. L. RIMULATUM, Peck. Peridium depressed—globose or broadly obovoid, plicate underneath with a slender fibrous mycelium. Cortex at first a thin, smooth, continuous fibrillose layer, gray or bluish-gray, sometimes with a purplish tinge; this at length breaks into a network of fine lines or fissures, gradually dries up into minute thin adnate scales, and finally falls away from the smooth grayish or purplish-brown surface of the inner peridium. Subgleba broad, but distinct, plane above, occupying about a fourth part of the peridium; mass of spores and capillitium purplish-gray, then brownish-purple; the threads simple or scarcely branched, variable in thickness, but always thinner than the spores; spores globose, distinctly warted, 6–7 mic. in diameter, often pedicellate. Plate I, Fig. 6.

Growing on the ground in fields and open woods. New York, *Peck*; South Carolina, *Atkinson*; Ohio, *Morgan*; Wisconsin, *Trelease*. Peridium $\frac{3}{4}$–1$\frac{1}{2}$ inches in diameter, scarcely an inch in height.

12. L. VELATUM, Vitt. Peridium globose or obovoid, with a cord-like root. Cortex white or yellowish, at first a thickish continuous layer, then breaking up into circular or irregular persistent patches with fimbriate margins. Subgleba occupying about a third part of the peridium; mass of spores and capillitium olivaceous, then purplish-brown; the threads branched, the main stem nearly as thick as the spores, the branches long and tapering; spores globose, distinctly warted, 5–6 mic. in diameter.

Growing on the ground in woods. South Carolina, *Ravenel*. Peridium 1–2 inches in diameter.

§2. OLIVE-SPORED SERIES. Mass of spores and capillitium immediately after deliquescence greenish-yellow, becoming when mature pale or brownish olivaceous, sometimes pale brown, rarely gray or argillaceous; the threads simple or branched, usually olivaceous in color by transmitted light, with a thickness about equal to the diameter of the spores, in a few species hyaline and two to three times as thick as the spores; the spores globose, rarely oval or elliptic, even or minutely warted, mostly sessile or with only a minute pedicel, rarely with a long persistent pedicel, often accompanied by the short hyaline sterigmata or their fragments.

A. Peridium obovoid or turbinate, the subgleba well developed.

f. Cortex of long spines mingled with shorter ones; the former at length fall away, leaving a reticulate surface to the inner peridium.

13. L. GEMMATUM, Batsch. Peridium turbinate, depressed above, the base short and obconic or more elongated and tapering or subcylindric, arising from a fibrous mycelium. Cortex consisting of long, thick, erect spines or warts of irregular shape, with intervening smaller ones, whitish or gray in color, sometimes with a tinge of red or brown; the larger spines first fall away, leaving pale spots on the surface, and giving it a reticulate appearance. Subgleba variable in amount, usually more than half the peridium; mass of spores and capillitium greenish-yellow, then pale brown; threads simple or scarcely branched, about as thick as the spores; spores globose, even or very minutely warted, 3.5-4.5 mic. in diameter.

Growing on the ground and sometimes on rotten trunks in woods, often cæspitose. New England, *Frost;* New York, *Peck;* New Jersey, *Ellis;* Pennsylvania, *Gentry;* Maryland, *James;* North Carolina, *Curtis;* South Carolina, *Atkinson;* Ohio, *Lea;* Wisconsin, *Trelease;* Kansas, *Cragin;* California, *Harkness.* Found in every part of the world. Peridium 1-2 inches in diameter and 1-3 inches in height. This species is distinguished from all others by the peculiar large erect terete spines or warts, the so-called gems which stud its upper surface.

14. L. PERLATUM, Pers. Peridium turbinate, broad and depressed above, plicate underneath and contracted into a short and pointed or sometimes elongated and tapering base; mycelium fibrous. Cortex of long slender spines, mingled with smaller spinules and warts, gray brown or blackish in color; the longer spines first fall away, leaving a reticulate surface to the inner peridium. Subgleba occupying one-third to one-half of the peridium; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; the threads mostly simple, some of them thicker than the spores; spores globose, even or very minutely warted, 3.5-4.5 mic. in diameter.

Growing on the ground in woods. New York, *Peck;* Maryland, *James.* Peridium 1–2 inches in diameter and 1–2 inches in height. This is *L. gemmatum* var. *hirtum* of Peck's U. S. species of Lycoperdon.

g. Cortex of stout spines which fall away and leave a tomentose or furfuraceous surface to the inner peridium.

15. L. EXCIPULIFORME, Scop. Peridium turbinate, depressed above, plicate below and contracted into a more or less elongated base. Cortex of large stout spines, convergent above, becoming smaller downward, which at length fall away, leaving a tomentose surface to the inner peridium. Subgleba occupying one-half or more of the peridium; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; the threads about as thick as the spores, scarcely branched; spores globose, minutely warted, 4–5 mic. in diameter.

Growing on the ground in meadows and woods. Pennsylvania, North Carolina, *Schweinitz;* Canada, *Saccardo.* Peridium 1–2 inches in diameter and 1–4 inches in height.

16. L. SEPARANS, Peck. Peridium broadly obovoid, often much depressed, plicate underneath, with a cord-like root. Cortex a dense coat of stout white convergent spines; after maturity these peel off in flakes or patches, revealing a thin furfuraceous layer of minute yellowish to pale or dark brown scales, covering the surface of the inner peridium; these also gradually disappear, leaving a pale, smooth, shining surface. Subgleba broad, occupying about a third part of the peridium, definitely limited above; mass of spores and capillitium pale to dark brown; the threads variable in thickness, but some of them thicker than the spores, scarcely branched; spores globose, even, 3.5–4 mic. in diameter. Plate II, Fig. 1.

Growing on the ground in pastures and meadows. New England, *Frost;* New York, *Peck;* South Carolina, *Atkinson;* Ohio, *Morgan;* Wisconsin, *Trelease.* Peridium 1–2 inches in diameter and about 1 inch in height. This is *L. separans* of Peck's 26th N. Y. Report and *L. Wrightii* var. *separans* of Peck's U. S. species of Lycoperdon. It is also no doubt *L. calvescens*, B. & C. Specimens of it may have been referred to

L. cruciatum, Rostk., but this species is said to grow on trunks of pines, and hence must be something different.

h. Cortex of long spines, curved and convergent at the apex, which fall away and leave a smooth surface to the inner peridium.

17. L. PEDICELLATUM, Peck. Peridium globose or broadly obovoid, with a slender fibrous mycelium. Cortex gray or whitish, changing to dirty-brown, consisting of long spines convergent at the apex; these at length fall away, leaving a wrinkled or obscurely pitted surface to the pale glabrous inner peridium. Subgleba rather small, occupying scarcely more than a fourth part of the peridium; mass of spores and capillitium olivaceous, then brownish; the threads much branched, the main stem thicker than the spores, the branches tapering; spores globose, even, 3.5–4.5 mic. in diameter, with long persistent pedicels. Plate II, Fig. 2.

Growing on the ground and on rotten wood in woods. New York, *Peck*; Alabama, *Atkinson*; Ohio, *Morgan*; Wisconsin, *Trelease*. Peridium ¾–1½ inches in diameter. The long persistent pedicels to the spores are the marked feature of this species; they do not break off and fall away in time, as in other species of Lycoperdon.

18. L. PECKII, Morg. Peridium obovoid, with a slender fibrous mycelium. Cortex whitish, ochraceous or brownish, sometimes with a reddish tinge, composed of long spines, usually curved and convergent at the apex; these finally fall away, leaving a pale, smooth surface to the inner peridium. Subgleba scarcely a third part of the peridium; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; the threads rather thinner than the spores, scarcely branched; spores globose, minutely warted, 4–5 mic. in diameter.

Growing on the ground or on decaying wood in woods. New York, *Peck*; New Jersey, *Ellis*; Alabama, *Atkinson*; Ohio, *Morgan*. Peridium 1–1½ inches in diameter. This is *L. echinatum* of Peck's U. S. species of Lycoperdon.

19. L. EXIMIUM, Morg. n. sp. Peridium obovoid, with a fibrous mycelium. Cortex white or brownish, composed of long slender spines, often curved and convergent at the apex, which at length fall away from above downward, leaving a

pale, smooth surface to the inner peridium. Subgleba small, occupying scarcely more than a fourth part of the peridium; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; the threads mostly thinner than the spores, much branched; spores oval, even, 5–6 × 4–4.5 mic., usually furnished with a short pedicel. Plate II, Fig. 3.

Growing on the ground in sandy soil. South Carolina, *Prof. Geo. F. Atkinson.* Peridium ¾–1½ inches in diameter and about 1 inch in height. This species is readily distinguished by its large oval spores.

20. L. CURTISII, Berk. Peridium globose, with a very short rooting base and a slender fibrous mycelium. Cortex consisting of a pale yellowish farinaceous layer, covered by a coat of soft, fragile white spines, curved and convergent at the apex; after maturity it soon disappears, leaving a pale smooth surface to the inner peridium. Subgleba small, but distinct, convex above and definitely limited; mass of spores and capillitium greenish-yellow, then pale olivaceous; the threads long, simple, hyaline, two to three times as thick as the spores; spores globose, even, 3.5–4 mic. in diameter. Plate II, Fig. 4.

Growing gregariously, and sometimes cæspitosely, on the ground, in meadows, pastures and even in cultivated fields. New England, *Wright;* New York, *Peck;* Maryland, *James;* Carolina, *Atkinson;* Ohio, *Morgan;* Wisconsin, *Trelease;* Kansas, *Kellerman.* Peridium ⅜–¾ of an inch in diameter. This is *L. Wrightii* var. *typicum* of Peck's U. S. species of Lycoperdon. The peculiar characteristic of the species is the hyaline threads of the capillitium; although they are of large diameter, yet the walls are very thin and the threads collapse in drying.

i. Cortex of minute spinules and granules or furfuraceous scales.

*Terrestrial.

21. L. MUSCORUM, Morg. Peridium turbinate, globose or depressed-globose above, contracted below into a stem-like base, with a filamentous and fibrous mycelium. Cortex a thin white or yellowish coat of minute spinules with intermingled granules, which are coarser toward the apex; these wither or shrivel with age and are mostly persistent on the smooth

olive-brown shining surface of the inner peridium. Subgleba occupying little more than the stem-like base; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; spores minutely warted, 4–4.5 mic. in diameter.

Growing among mosses, especially Polytrichum, in old meadows and pastures. New York, *Peck.* Peridium ½–1⅓ inches in diameter and 1–3 inches in height. This is *L. molle* of Peck's U. S. species of Lycoperdon. "From the long-stemmed puff-ball (*Calvatia elata*) it is with difficulty separated in its immature state, but when mature the different manner in which the peridium in the two species ruptures will at once distinguish them. From its habit of growing among mosses the stem is often elongated, and is sometimes very slender in proportion to the size of the peridium."

22. L. TURNERI, E. & E. Peridium obovoid, somewhat depressed above, plicate underneath, with a mycelium of rooting fibers. Cortex white, often gray or brownish above, consisting of minute spinules with intermingled granules; these after maturity dry up and are quite persistent, forming a minutely scabrous coat on the olive-brown shining surface of the inner peridium. Subgleba broad and shallow, scarcely occupying more than a fourth part of the peridium; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; the threads with the main stem about as thick as the spores, and long tapering branches; spores globose, minutely warted, 4–5 mic. in diameter, mostly with a short pedicel. Plate II, Fig. 5.

Growing on the ground in woods. Labrador, *Mr. L. M. Turner;* New Jersey, *Ellis;* New England, *Humphrey;* New York, *Underwood;* Carolina, *Atkinson;* Ohio, *Morgan;* Wisconsin, *Brown.* Peridium 1–2 inches in diameter and 1–2 inches in height. A very pretty puff-ball with a silky shining coat.

23. L. MOLLE, Pers. Peridium turbinate, depressed above, abruptly contracted into a short thick base, with a fibrous mycelium. Cortex a thin, mealy-furfuraceous, subpersistent coat, white or yellowish, passing into buff; when this finally falls away it discloses a smooth, shining, pale olivaceous surface to the inner peridium. Subgleba occupying about a third part of the peridium; mass of spores and capillitium greenish-yellow, then brownish olivaceous; the

threads about as thick as the spores, branched; spores globose, very minutely warted, 3.5–4.5 mic. in diameter, with a minute pedicel.

Growing on the ground in open woods and pastures. Wisconsin, *Trelease.* Peridium ½–1¼ inches in diameter and ¾–1½ inches in height. "This species superficially resembles small plants of *L. glabellum* so closely that it is difficult to distinguish them." The spores, however, "afford constant and certain means of distinguishing them."

k. Cortex of minute spinules scales or granules,

** Lignatile.

24. L. PYRIFORME, Schaeff. Peridium obovoid or pyriform, with an abundant mycelium of very long white branching fibers. Cortex a thin coat of minute scales or granules or short stout spinules, whitish gray or brownish; it is quite persistent, drying up and becoming reddish-brown in color and often rivulose or areolate. Subgleba small, white, quite compact, the cells minute; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; threads thicker than the spores, branched, those in the center very long and forming a dense tuft; spores globose, even, 3.5–4.5 mic. in diameter.

Growing on old timber or sometimes on the ground; usually cæspitose, sometimes in dense clusters several feet in extent. New England, *Frost;* New York, *Peck;* Pennsylvania, *Schweinitz;* North Carolina, *Curtis;* Ohio, *Lea;* Wisconsin, *Trelease;* Kansas, *Cragin;* California, *Harkness.* Peridium ¾–1¼ inches in diameter and 1–2 inches in height. The commonest of all puff-balls, distributed throughout the whole world.

25. L. SUBINCARNATUM, Peck. Peridium globose, sessile, with a mycelium of long branching white fibers. Cortex pinkish-brown, composed of minute short stout spinules, which fall away after maturity, leaving the surface of the inner peridium deeply pitted. Subgleba quite small, but usually distinct; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; threads long, simple, hyaline, once to twice as thick as the spores; spores globose, minutely warted, 4–4.5 mic. in diameter. Plate II, Fig. 6.

Growing in woods on old trunks. New York, *Peck;* Pennsylvania, *Gentry;* Ohio, *Morgan;* Wisconsin, *Brown.* Peridium ¾–1¼ inches in diameter. A singular species well marked by its very distinctly pitted inner peridium, the little pits resembling those in a thimble. It is also one of the few species with simple hyaline threads.

B. Peridium very small, globose; the subgleba nearly obsolete.

I. Cortex a thin coat of minute spinules, scales or granules.

26. L. WRIGHTII, B. & C. Peridium globose, sessile, with a fibrous mycelium. Cortex a thin, whitish, minutely fibrillose-spinulose coat, the spinules often convergent at the apex, drying up and quite persistent on the pale brown surface of the inner peridium. Subgleba obsolete; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; the threads variable in thickness, sparingly branched; spores globose, even or very minutely warted, 3.5–4.5 mic. in diameter, often with a minute pedicel.

Growing on the ground in woods. New England, *Wright;* New Jersey, *Ellis;* Ohio, *Morgan.* Peridium ½–¾ of an inch in diameter.

27. L. PUSILLUM, Batsch. Peridium globose, sessile, with a slender cord-like root. Cortex a thin whitish furfuraceous coat, drying up into minute squamules which are quite persistent on the pale brown surface of the inner peridium. Subgleba obsolete; mass of spores and capillitium greenish-yellow, then brownish-olivaceous; the threads very much branched, the main stem about as thick as the spores, the branches tapering; spores globose, even, 3.5–4 mic. in diameter, often with a minute pedicel. Plate II, Fig. 7.

Growing on the ground in fields and open woods. New York, *Peck;* North Carolina, *Curtis;* Ohio, *Morgan;* Wisconsin, *Trelease;* Kansas, *Cragin* Peridium ⅜–¾ of an inch in diameter.

28. L. OBLONGISPORUM, B. & C. Peridium subglobose, with a slender mycelial cord. Cortex a thin, whitish, furfuraceous coat, drying up into minute persistent granules on the pale brown surface of the inner peridium. Subgleba nearly

obsolete; mass of spores and capillitium olivaceous, then brown; threads much branched, the main stem about as thick as the spores, the branches tapering; spores elliptic, even, 5–6 × 3–4 mic., sometimes with a minute pedicel.

Growing on the ground in dense woods. Wisconsin, *Trelease.* Peridium ⅜–1 inch in diameter. "This pretty species previously known only from Cuba, is indistinguishable from *L. pusillum* when immature, the spores affording the only really characteristic feature."

29. L. CEPÆSFORME, Bull. Peridium globose or depressed-globose, plicate underneath, with a cord-like root. Cortex at first a thin, white, minutely furfuraceous coat, this soon becomes rimulose and at length breaks up into small scales and patches, which finally disappear from the pale or pale-brown surface of the inner peridium. Subgleba nearly obsolete; mass of spores and capillitium greenish-yellow, then pale-olivaceous; the threads very much branched, the main stem thicker than the spores, the branches long and tapering; spores globose, even, 3.5–4 mic. in diameter, often with a minute pedicel. Plate II, Fig. 9.

Growing on the ground in meadows and pastures. Pennsylvania and Carolina, *Schweinitz:* Alabama, *Atkinson:* Ohio, *Morgan.* Peridium ½–1 inch in diameter. Fries appears to have included this species with *L. pusillum*, and the smaller forms are certainly very liable to be referred to that species. Saccardo includes these species and two or three others under *L. furfuraceus*, Schaff. We have been guided by Massee and Quelet. *L. pratense* of Schweinitz's N. A. Fungi we take to be this species.

30. L. COLORATUM, Peck. Peridium, subglobose, plicate underneath, with a fibrous mycelium. Cortex a thin coat of very minute persistent granules, whitish or yellow, becoming reddish or pale brown, or finally dark brown with age. Subgleba nearly obsolete; mass of spores and capillitium at first pale yellow, then brownish-olivaceous; threads very much branched, the main stem thicker than the spores, the branches tapering; spores globose, even, 3.5–4.5 mic. in diameter, often with a minute pedicel. Plate II, Fig. 10.

Growing in low grounds in woods. New England, *Morgan*; New York, *Peck:* Ohio, *Morgan:* Wisconsin, *Trelease.* Peridium ⅜–1 inch in diameter.

31. L. ACUMINATUM, Bosc. Peridium globose, then ovoid, with a mycelium of fine white fibers. Cortex a white soft delicate continuous coat, drying up into a thin furfuraceous persistent layer on the surface of the inner peridium. Subgleba obsolete; mass of spores and capillitium pale-olivaceous, then dirty gray; threads simple, hyaline, two to three times as thick as the spores; spores globose, even, 3 mic. in diameter. Plate II, Fig. 8.

Growing on the mosses of old logs and about the base of living trees. New York, *Peck*: North Carolina, *Curtis*: South Carolina, *Revenel*, *Atkinson*: Ohio, *Morgan*: Costa Rica, *Oersted*. Peridium ¼–½ of an inch in height. The peridium is at first globose, the ovoid form appears with the formation of the mouth; both forms may be seen on the same patch of moss. This species was first described under this name in the Novae Symbolae of Fries; it next appears under the same name in Curtis's Catalogue, but incorrectly ascribed to B. & C. *L. calyptraeforme*, Berk, and *L. leprosum*, B. & Rav., are synonyms of this.

NOTES ON THE BATRACHIANS AND REPTILES OF VIGO COUNTY, INDIANA.

By W. S. Blatchley.

(Read by Title February 3, 1891.)

For the past three years the writer has given especial attention to the Batrachians and Reptiles found in the vicinity of Terre Haute, Vigo County, Indiana. In that time forty-six species and six sub-species of these interesting vertebrates have been observed in the locality mentioned, and many notes have been taken relating to their habits, the causes of their local distribution, etc.

Believing that a list of those seen, together with some of the notes, would prove acceptable to persons interested in the study of herpetology, the present paper has been prepared.

Vigo County lies on the western border, and almost midway between the northern and southern boundaries of the State. The Wabash River flows through its north-western part, and in many places its bottoms, which are usually overflowed each season, are one to two miles in width.

In these bottoms are a number of large ponds, some of them covering an area of forty to sixty acres, which are the favorite resorts of many of the batrachians and not a few of the reptiles mentioned below. The city of Terre Haute is on the eastern bank of the river, on the edge of a prairie about two miles in width, beyond which a low range of hills forms the western border of a tableland which extends to the eastern limit of the county. At the point where the tableland meets the prairie the soil is a loose, black loam, containing a great deal of sand. Here, in a woodland pasture of about forty acres, rather thickly grown up with underbrush, and having near its center several shallow ponds, about the margins of which are numerous logs, have been collected no less than thirty-two of the forty-five species found in the county. Of course, many of these have been taken elsewhere, but the sandy soil and other conditions of this woods seems to suit

the salamanders and tree frogs, especially, as out of ten species of the former and four of the latter all but one have been seen here, and nine of the fourteen nowhere else in the county.

On one afternoon in October a class of fifteen zoölogy pupils took forty-six specimens of salamanders, representing four species, from this place, and on two other occasions the writer has found there six different species of the same animals within less than an hour's time. I have been thus specific in mentioning the above locality, because I believe that upon the character of the soil, rather than upon other conditions, such as latitude, temperature, etc., depends to a great extent the distribution of our batrachians and reptiles. For example, the genus *Spelerpes* is represented in Indiana by three species, *bilineatus*, *longicauda* and *ruber*. All of them are rather common throughout the central and southern portions of the State where limestone rocks and a drift or clay soil abound, whereas but a single specimen of one species, *bilineatus*, has been found in Vigo County, and it was taken, not from the loose sandy soil above mentioned, but from a worn out field, where the soil was wholly clay.

In the list which follows, the nomenclature and order of the Batrachians is that of Cope's recent and standard work, on "The Batrachia of North America;" while the revised edition of Jordan's "Manual of Vertebrates" has been followed in the naming of the reptiles. Where the species has been recorded from not more than two other stations in the State, those records are mentioned that the list may prove more valuable to future collectors.

BATRACHIA.

PROTEÏDA.

PROTEIDÆ.

1. NECTURUS MACULATUS, Raf.—Water Dog.—Mud Puppy.

Common in the Wabash River. Specimens two feet long and over are often taken in the Spring and Fall. Although some of the older fishermen have caught hundreds of them, they yet believe the bite of the animal to be very poisonous, and they either crush its head before attempting to remove the hook, or else cut the line and allow it to escape.

URODELA.

AMBLYSTOMIDÆ.

2. Amblystoma opacum, Gravenhorst—Marbled Salamander.

A single specimen, three and a half inches in length, was taken October 21, 1890, from beneath a log in sandy, upland woods. It was within six inches of a specimen of *Eutainia saurita*, and not more than a foot away were two spotted salamanders. Its previous Indiana records are New Harmony (Sampson) and Wheatland (Ridgeway).

3. Amblystoma punctatum, Linn.—Spotted Salamander.

Common in dry upland woods with a sandy soil. Numerous specimens from an inch and a half to six inches in length were taken November 2, 1890, the young being colored similarly to the adults.

4. Amblystoma tigrinum, Green—Tiger Salamander.

Three years ago this was the most common *Amblystoma* in the county, *A. punctatum* being seldom seen. Now the latter far outnumber the former, and but few *tigrinum* are to be found. They frequent both upland and bottom woods, and quite often find their way into cellars in the city. The color of this species depends greatly on the age, old specimens having the yellow spots large, and in some individuals covering more of the surface than the brown, whereas, on June 2, 1888, eleven young about three inches in length were taken, almost all of which were uniform brown.

5. Amblystoma jeffersonianum jeffersonianum, Green.
Jefferson's Salamander.

An uncommon species, but two having been taken. They were found in sandy woods, at some distance from water, October 21, 1890.

6. Chondrotus microstomus, Cope—Small Mouthed Salamander.

Quite common, and in this vicinity more often found beneath logs near the margin of ponds and in low damp places, than in dry woods. A single specimen, seemingly as lively as

in Summer, was taken January 11, 1890, from beneath the fine drift deposited near the margin of the high ground by an excessive rise in the river. Another, with a large mass of eggs, from some of which the young were escaping, was brought in from a pond on February 16.

PLETHODONTIDÆ.

7. HEMIDACTYLIUM SCUTATUM, Tschudi—Scaly Salamander.

Five specimens of this handsome little animal have been taken. One was found near the margin of a pond, on May 4, the others on two different occasions in late Fall, in dry woods. One of the latter had the entire upper side of tail of the same shade of yellow as the upper jaw. Other State records are Franklin and Marion Counties.

8. PLETHODON CINEREUS CINEREUS, Green.

8. (*a.*) PLETHODON CINEREUS ERYTHRONOTUS, Green.—Red-Backed Salamander.

These are the most common salamanders found at a distance from water in upland woods with a clay soil. They are seldom found in a sandy soil, and never, so far as the writer is aware, in the low, damp bottoms. They are about equal in numbers, and often five or six half grown individuals of each variety are found beneath the same log.

9. PLETHODON GLUTINOSUS, Green.—Slimy Salamander.

Frequent in upland woods with both sandy and clay soils. Usually not far from water, but never in it. The bluish white markings vary greatly in numbers and size even in adult specimens. On some they are no larger than pin heads, and are distributed regularly over the entire upper surface and sides. On others they are five or six times as large, and are almost wholly limited to the sides. Recorded before only from Monroe county.

19. SPELERPES BILINEATUS. Green—Two-Lined Salamander.

Rare, but one specimen having been taken or seen. It was found in a worn out field, where the soil was wholly clay.

11. Diemyctylus viridescens viridescens, Raf.—Green Triton.—Newt.

The form *viridercens* of this handsome variety is the only aquatic salamander found in the county, and it seems to be scarce, but two or three specimens having been secured from cisterns and ponds. The form *miniatus*, Raf., is more frequently taken and is found beneath logs, usually in sandy upland woods, and always at a distance from water. There is also found a dark colored form, of which a half dozen individuals have been taken; one large one from the waters of a cistern; the other five, smaller, from beneath logs near the margin of ponds. They have the back and sides very rough, as in form *miniatus*, and are *wholly devoid of the vermilion spots*, which are found in both *viridescens* and *miniatus*. The ones found beneath the logs were taken on November 2. They average two and a half inches in length, and have the back and sides to below the middle almost wholly black. The one from the cistern was taken November 9, and is three and a half inches long. It is less dark than the preceding, the sides being heavily shaded with mottlings of dusky.

This, perhaps, is but a form of the above variety, the change in color being due to some special environment which it undergoes It is not mentioned by Cope, nor by any one else, as far as I am aware. Prof. O. P. Hay informs me since the above was written that he has a single specimen, similar to the form mentioned, which was taken at Brookville, Ind.

TRACHYSTOMATA.

SIRENIDÆ.

12. Siren lacertina, Linn.—Mud Eel.—Siren.

Three specimens of this rare batrachian have been taken in recent years, two of which are now in the collection of the State Normal School. They were captured in a pond in the river bottoms on March 22, 1890. The third had been taken the April preceding in a similar locality. Hay records it from New Harmony, and Cope, on the authority of Profs. Coulter and Jordan, from Lafayette and the White River, respectively.

SALIENTIA.

BUFONIDÆ.

13. BUFO LENTIGINOSUS AMERICANUS, LeConte.—American Toad.

Common and exceedingly variable in color, some specimens being wholly black above.

HYLIDÆ.

14. ACRIS GRYLLUS CREPITANS, Baird.— Cricket Frog.— Peeper.

This is the most abundant tailless batrachian in the county. Hundreds can be seen along any small stream in Spring and Autumn. They appear less common in Summer, but are active in certain localities even in midwinter, lively specimens having been taken on December 23, January 9, and February 16.

15. CHOROPHILUS TRISERIATUS, Wied—Swamp Tree Frog.

Rare, a single specimen having been taken from the edge of a pond on June 2. "Marion and Franklin Counties."

16. HYLA PICKERINGII, Storer.—Pickering's Tree Frog.

Four specimens of this interesting little frog were taken in 1890; two from the margin of a pond, in the woods mentioned in the introduction, on April 8, where they had evidently resorted for the purpose of depositing their eggs, and two on June 5 in the same woods, but a distance from water. The first two were kept in captivity for several weeks, and regularly at about 8 P. M. they began their shrill piping notes, keeping them up for almost an hour, after which they were silent till the next evening. Preceding each note the vocal sac of the throat expanded until it was two-thirds as large as the animal itself, when suddenly the air thus collected was forced out, producing the sound by its escape. The only previous Indiana record is Monroe County.

17. Hyla versicolor, LeConte.—Common Tree Frog.

Abundant; as many as five have been taken in November, within an area of a square foot, from beneath the bark of an oak log.

RANIDÆ.

18. Rana virescens virescens, Kalm.—Leopard Frog.

The most common of our larger frogs, especially about the river bottom ponds. It, also, is gregarious, a dozen or more being often found beneath a small log in late Autumn or early Spring.

19. Rana palustris, LeConte.–Pickerel Frog.–Swamp Frog.

A rare species in this locality, but two having been seen. They were taken in May from the grassy margin of an upland pond. Previously recorded from Monroe and Franklin Counties.

20. Rana clamata, Daudin.—Green Frog.— Spring Frog.

A common frog about all upland streams and springs, but seldom seen in the low lands. Never more than one or two are found in a place. During the open Winters of 1888–89 and 1889–90 several specimens of this, as well as of *virescens*, were seen on different occasions in December and January. On February 16, 1888, they, together with the "peepers," were in full chorus.

21. Rana catesbiana, Shaw.—Bull Frog.

Frequent; found from April to October in the larger lowland ponds and the deep still waters of streams, but is more often heard than seen. Its numbers are becoming less year by year, a fact, no doubt, due to the taste which man has developed for its tender thighs.

22. Rana sylvatica, LeConte.—Wood Frog.

A frequent species in dense, damp woods. Difficult to capture on account of its quickness and enormous leaps.

Of the twenty-seven batrachians mentioned by Prof. O. P. Hay, in his "Catalogue of the Amphibia and Reptilia of Indiana," published in 1887, the above twenty-two have been taken within a radius of five miles of the city of Terre Haute.

REPTILIA.

OPHIDIA.

COLUBRIDÆ.

1. STORERIA OCCIPITOMACULATA, Storer.—Red-Bellied Snake.

This handsome little snake is rare in Western Indiana, and for that matter throughout the State. A single specimen taken from beneath a log in upland woods represents what is known of the species in Vigo County.

2. STORERIA DEKAYI, Holbrook.—DeKay's Brown Snake.

Rather frequent, especially in Spring. I have never found it near the water, although W. H. Smith, in his Report on the Amphibians and Reptiles of Ohio, says that it is aquatic.

3. TROPIDOCLONIUM KIRTLANDI, Kennicott. — Kirtland's Snake.

This species is rare in Vigo County, where but two specimens have been taken, but in Putnam County, forty miles northeast, it is rather common. It must be nocturnal in its habits, as every one of the half dozen or more specimens which I have seen were found coiled up beneath logs or stones, and usually close to small streams.

4. EUTAINIA SAURITA, L.—Riband Snake.—Slender Garter Snake.

This graceful snake is quite common, and is usually found in the vicinity of water, but has never been seen by the writer to enter it. For three years it has been the first species seen in Spring—the dates being March 23, 18 and 22, respectively.

5. EUTAINIA FAIREYI, Bd.-Gr.—Fairie's Garter Snake.

Rare. Two specimens in the collection of the State Normal School and one in my own are all that I have seen. Vigo County is probably near the eastern limit of its range.

6. EUTAINIA SIRTALIS, L.—Common Garter Snake.

6. (*a*.) EUTAINIA SIRTALIS ORDINATA, L.—Grass Snake.

6. (*b*.) EUTAINIA SIRTALIS DORSALIS, Bd.-Gr.

6. (*c*.) EUTAINIA SIRTALIS PARIETALIS, Say.—The Red-Sided Garter Snake.

All four of the above varieties of this variable species are found in the county, *sirtalis* and *parietalis* being our most common snakes. *Ordinata* and *parietalis* are mostly found in upland fields; the other two about the lowland ponds. During the high waters, in the second week of January, 1890, several snakes were reported seen about the river, and on the afternoon of the 11th I set out to verify the report, and after a short search found two specimens, one *sirtalis*, the other *parietalis*, beneath some fine drift near the margin of the overflowed bottoms. Although it was midwinter, they were not sluggish in their actions, both making a lively attempt to escape when disturbed.

7. REGINA LEBERIS, L.—Queen Snake.—Leather Snake.

This species, recorded heretofore only from Montgomery and Franklin Counties, is common in all the larger streams in this portion of the State, having been taken by the writer in Putnam, Owen and Vigo Counties. Unlike the next species, it is seldom, if ever, found about deep pools or ponds, but frequents shallow, running water, gliding gracefully among the stems of the water willow (*Dianthera Americana*), and other aquatic plants, and when pursued takes refuge beneath one of the many stones usually found in such a place.

8. TROPIDONOTUS SIPEDON, L.—Water Snake.—Water Moccasin.

An abundant species, especially about the river bottom ponds, where it grows to be of enormous size. It is most commonly known as the water moccasin, and is usually given a wide berth—nine persons out of ten believing that its bite will cause certain death. It feeds principally on frogs, no less than seven large specimens of *Rana virescens* having been

found in the stomach of one which was dissected on account of its aldermanic appearance.

9. COLUBER OBSOLETUS, Say.—Pilot Snake.

A large and rather common snake, found in dry, open woods, oftentimes in trees and bushes. A specimen five feet, seven inches long was kept for some time in captivity in a vacant room. When approached it would vibrate its tail very rapidly from side to side, producing a distinct rattling sound, and on entering the room at night with a lamp it would hiss with a loud gurgling noise. A large specimen of the great horned owl, *Bubo Virginianus* kept in the same room was finally attacked by the snake, and when discovered the latter had two coils tightly wrapped about the owl, and had crushed it so badly that it soon died.

10. CYCLOPHIS ÆSTIVUS, L.—Summer Green Snake.

At least a dozen specimens of this beautiful and usually rare snake have been taken. It is found on rocky hillsides, most commonly in the vicinity of running water. I have also seen two specimens in blackberry bushes, about four feet from the ground. A specimen kept in captivity in a glass case often rested upon the lower half of its body and raising the other half almost vertically, it would remain rigid and motionless for ten or fifteen minutes at a time.

11. BASCANION CONSTRICTOR, L.—Black Snake.—Blue Racer.

Formerly very common throughout the State, but becoming much less so each year, as nine out of every ten seen are usually killed out of pure wantoness by persons who know nothing of their vermin-eating habits. Another cause of their lessening numbers is undoubtedly the rapid disappearance of the old Virginia rail fences, beneath the bottom rail of which they were sure of a safe retreat from all attacks. A few are seen every year in this vicinity, and if met with in late Fall, when they are seeking a hibernaculum, are very vicious, hissing and striking at a person even when several yards away. The young are very different in color from the old, being olive brown, with numerous large, darker colored spots along the sides.

12. Diadophis punctatus, L.—Ring-necked Snake.

Rare, but two specimens having been seen. Both were found beneath the same fence rail on a hillside having a southern exposure.

12. (*a*.) Diadophis punctatus amabilis, Baird & Girard.

A single specimen of this western variety is in the writer's collection, and was taken May 12, 1889, from beneath the bark of a fallen tree. It has no other Indiana record, but is said to be occasionally found in Ohio.

13. Ophibolus getulus savi, Holbrook.—King Snake

A small specimen of this handsome snake was taken on the 22d of October, 1888, and so far as known is the only one which has been seen in the State. It has, however, been taken at Mt. Carmel, Illinois, just across the Wabash River from Indiana.

14. Ophibolus doliatus, L.—Red Snake.—Corn Snake.

The typical *doliatus*, which has been taken before only in Brown and Posey Counties, is represented from Vigo by two specimens, one in the collection of the Normal School, and the other in that of the writer. Nothing is known concerning its habits.

14. (*a*.) Ophibolus doliatus triangulus, Boie. — House Snake.—Milk Snake.

This variety of the above species is one of our most common reptiles, and as its name indicates, is often found about dwellings and outbuildings. The arrow-shaped occipital spot is as often absent as present, and the size and shape of the blotches vary in every conceivable way. A specimen seen by the writer had an unbroken grayish white dorsal stripe about eight inches in length.

15. Heterodon platyrhinus, Latreille.—Spreading Adder. Blowing Viper.

This species is also very common, especially in early Spring (March 22, 1890), when they are found in small companies on

sandy hillsides and prairies. The var. *niger* is almost as frequent as the typical species, and, in the writer's opinion, is but a mere form. On April 13, 1889, a specimen of *niger* was found in copulation with one of the typical *platyrhinus*, while but a foot or two away was another *platyrhinus*. When separated they opened wide their mouths, turned on their backs, and coiled and twisted about in a very rapid and curious manner for about five minutes, when they became quiet and apparently lifeless. During all these contortions they had remained on their backs, and when they became quiet and were turned over they would immediately turn on their backs again, but otherwise gave no signs of life, even at the end of an hour's time. By every one except the student of herpetology this is considered one of the most venemous of snakes, but by experience I know that its bite is no more painful than that of a mouse.

CROTALIDÆ.

No specimens of this family have been seen by the writer within the county, and hence none are included in the catalogue. If, however, the snake stories of the older inhabitants can be relied upon, two species of rattlesnakes and the copperhead were once frequently to be found in suitable localities throughout the county.

LACERTILIA.

SCINCIDÆ.

16. Eumeces fasciatus, L.—Blue-tailed Lizard.

This is the only species of lizard found within the county, and it is not often seen. It frequents dry upland woods, usually hiding beneath logs and stones, but has been observed on several occasions high up on the trunks of trees.

TESTUDINATA.

TRIONYCHIDÆ.

17. Amyda mutica, Le Sueur.—Leather Turtle.

A single specimen from the Wabash River is in the writer's collection. It is, no doubt, frequently taken by the fishermen who confound it with the next species, applying the

name "soft-shelled turtle" to both. From the State it has been recorded from Delphi and Madison.

18. Aspidonectes spinifer, Le Sueur. — Common Soft-Shelled Turtle.

An abundant species in all streams, and the one most utilized as food. I have seen it moving freely about in the water as late as December 11 and as early as March 19.

CHELYDRIDÆ.

19.' Chelydra serpentina, L.—Common Snapping Turtle.

This common turtle grows to a very large size in the river bottom ponds, from which it is often taken and used as food, especially in making the turtle soup sold in the saloons. It is more frequently found in stagnant water than any other species. During the severe drouth of the past Summer, when the beds of most of the streams were dry or nearly so, five specimens, none of which weighed less than eight pounds, were taken from a mudhole in a small creek. The size of the hole was about 12 x 3 x 2 feet. Each of the turtles had at least fifty fresh water leeches attached to the sides of the neck or to the carapace.

EMYDIDÆ.

20. Malaclemmys geographicus, Le Sueur.—Map Turtle.

Rather common in the river and larger streams, but seldom seen except when captured in a seine.

21. Malaclemmys lesueuri, Gray.—Le Sueur's Map Turtle.

A single specimen was taken from the roadside, over a half mile from water, in May, 1888. It is said by Hay to be found throughout the State, but is evidently scarce.

22. Chrysemys marginata, Agassiz.—Painted Turtle.

An abundant species about ponds and the deeper pools of streams. It is one of the first turtles seen in Spring, the dates for the last three years being March 7, 11 and 21, respectively. *C. picta* has never been seen by the writer in western Indiana.

23. CISTUDO CAROLINA, L.—Common Box Turtle — Land Terrapin.

This is the only truly terrestrial turtle found in the county. It is common in sandy upland woods, but has never yet been seen in the bottoms. The young evidently remain hidden for a number of years, for out of perhaps fifty individuals seen by the writer the smallest was four and a half inches in length. Specimens of the box turtle were taken in 1890 as early as April 8 and as late as November 22, and on two different occasions it has been observed to feed upon a species of fungus growing upon an oak log.

There are doubtless other reptiles, especially turtles, to be found in the county, but the above are all that have been seen by the writer.

Since writing the foregoing the following captures have been made in the hillside woods noted in the introduction:

AMBLYSTOMA OPACUM—Gravenhorst.

Two more specimens of this salamander were taken from beneath logs on March 22d and 28th respectively. When disturbed they seem to be more active than the other species of *Amblystoma* found with us.

CARPHOPHIOPS HELENÆ, (Kennicott) Helen's Snake.

A single specimen of this graceful little reptile was found coiled up in some dead leaves on April 14th. This is, as far as known, the most northern station from which it has been recorded.

"A CINCINNATI BOY IN THE TROPICS."

BY CHARLES DURY.

[Read April 7th, 1891.]

TRAVELS OF WM. DOHERTY.

In the Spring of 1873 there came to my work shop in Avondale, a small, pallid, feeble looking boy, whose head seemed to be too large for his body. His well chosen language and sage remarks indicated an "old head on young shoulders." I never saw any one so completely infatuated with natural history. He wished to accompany me on expeditions after birds and insects. On the first day's trip he became sick, and I was obliged to leave him exhausted on a log. But his determination was strong and he tried it again, the long tramps developed and strengthened him. In March, 1878, William Doherty being then twenty years old, sought and obtained an appointment as an assistant of the "Smithsonian Institution" to the Paris Exposition, in charge of the United States exhibit. After filling, in a creditable manner, his duties, he received his discharge, and started off to see Europe on foot, leaving Paris late in July, and going to Holland, Germany, and Italy, diligently studying French and German, arriving at Venice in October. From there he went to Turkey, arriving at Constantinople November 16th. From there he pushed on to Greece, traveling all through that country on foot, living cheaply in monasteries. The people were most delightful, and treated him with the greatest hospitality. The language spoken was the ancient Greek, in its greatest purity, even by the common people. He located near Athens, and devoted a year to the study of language. During 1880 he tramped over the Holy Land, living with the missionaries, one of whom, Rev. Mr. Eaton, said he had a phenomenal talent for language. During his tramp over Egypt he corresponded for the New York *Tribune*. He then went to Erzerum, arriving November 22, 1880. Here he bought an Arab horse he

called "Alp," for a grand trip through Persia; went to Mt. Ararat, and got into Russian territory, but was promptly escorted out by the authorities. He rode around the Caspian Sea, visiting the places famous in the "Arabian Nights," mastering the Persian language as he traveled, studying by moonlight and living with the people. At Persopolis he made a careful study of the famous ruins. Had a severe attack of "Caspian fever," but recovered. Came to Rescht May 6, 1881, from there around to Asterabad, and thence via Teheran, traveling with a caravan down to the Persian gulf to Shiraz, where he sold his Arab steed. On this horse he had traveled hundreds of miles, sleeping at night between his fore and hind legs to keep warm, eating and living with the noble brute. The parting from this animal was a very sad one, and made him sick. He says, near Shiraz the Asiatic lion begins to show itself, but is not nearly so dangerous as the tiger of India. March, 1882, finds him yet on the Persian Gulf at Muscat, in Arabia, deeply engaged in the study of fishes, under the direction of Dr. Jayako, a Mahretta and man of science, who has Günther's great work on fishes. Here he dissected and preserved fishes. He reveled in the gorgeous tropical fish and coral groves. He says, "I have been dissecting to-day black looking things that look like bits of broken sticks a foot long; these are 'Tripang' or 'Sea Cucumbers.' I am working on these in view of my future profession" (natural history). He now having gotten well out of reach of parental control, for the first time mentions the object so dear to his heart, and to which he proposes to devote his life, the study of nature. His parents had forbidden this, wishing him to study law. From the Persian Gulf he went through Beloochistan and Afghanistan and thence to the "Punjab" and the "Vale of Cashmere," all the time collecting butterflies, which he sent to Europe to be sold. He worked along the southern slope of the Himalayas, traveling with the sheep-herders, who transport merchandise on the backs of their sheep into remote places, where they take them in search of new pastures. He once received three letters from his mother, that were being transported (with mail) on the back of a sheep, in search of him. From the Punjab he went to Lucknow, to study the details of the Sepoy insurrection. In a letter from Notinga, State of Jaipur, December 20, 1882, he

says: "These simple children of nature, the 'Kandhs,' a few years ago used to buy slaves from the low country and sacrifice them on the altar, for the benefit of the next year's crop; an old chief informed me that since this practice had been stopped, they had never had as good crops. I had established myself at a camp by the roadside, eleven miles from Sunki, and had there a rather serious experience. While working successfully this zoologically unknown country, the cholera broke out with great force, and every body deserted that could. I managed to keep my old cook, by not paying her all of her wages (the great secret of keeping servants in this country); even the dresser or surgeon ran away, leaving the sick to their fate. There were more than thirty people left in the camp, many of them in a half dying state, though some had passed the crisis of the disease; they were all huddled into two or three huts to escape the tigers, which they seemed to fear more than fresh contagion. The only well people in the camp were myself and Mushaludi, my cook, and her daughter. (Mushaludi was a great thief; the fowls she cooked for me always lacked their full complement of legs and wings). I took a sort of grim pleasure in this affair so far, and made a trip to the top of the highest mountain in this country and got some new insects near the summit. On my way home from this trip I passed a burned village, the poor people mourning over the ashes, and grubbing up their scant stock of "Paddy" from the ruins. Many of them died of hunger and cold. I made a trip to a neighboring village, to try and get help for the sick, but I found the people not much concerned with the affairs of this world. They were dying like flies! On January 14th I was taken sick; the same evening I met a leopard in the camp, but he ran away. I went into my hut that night, I heard the hyenas shrieking all night, and some one sneaked in and stole my rice. I dosed myself with chlorodyne; that stopped the disease, but left me almost insensible. When I recovered, and, though very weak, I went out; no one was alive in the camp. I saw one man's body half eaten up by wild beasts, and a girl that I thought was getting better was dead, and teeth marks showed the cause of her death. About thirty people are supposed to have died in and around this camp." From this pestilential country Doherty went to the Island of Ceylon, August 11th, working

all the time on the natural history of the country, and selling his collections to pay his expenses. From Ceylon he went to Calcutta. He had letters to the Indian Museum and also to British officers, who invited him to go on elephants to visit the Queen of Burma; each elephant had a retinue of seventy men to cut paths and drive away tigers. An elephant can go almost any where, but a path must be cut, as the bamboos and other vegetation would sweep the rider off, if not cut out of the way. They were royally received by her Majesty, the Queen, who chewed tobacco and expectorated into little dishes, and passed it around for her guests to taste, as a great mark of esteem! Doherty says, "I made up my mind I would die before tasting it." On his return to Calcutta, he obtained permission from the government to visit the Andaman Islands, and was kindly received at the penal settlements on Christmas, 1884. In attempting to go over to another one of these islands in a small boat, he was fired on by the natives, and his Chinese boatman killed with a poisoned arrow, but he landed, and with a liberal use of presents, made friends of the natives, and secured fine collections of the insect fauna. He went to the Nicobar Islands, and afterwards again to the Andamans. In 1885 he collected butterflies at Madras and Bombay. In 1886 he visited Benares to write up the old wares, china and brasses, and the old idols in the Mogul temples, for the London *Times*. Writing from Sarti, he says, "I came here on an elephant with a guard of Sepoys, and am catching lots of butterflies. I never saw bamboo used for such a variety of purposes as here. A Coolie is now boiling my tea in a joint of it. These people use it for most every thing." While in Benares he engaged some Lepchas, who are the most skillful butterfly catchers in the world. He says, "the two pests of this country are tigers and the deadly cobra, and I am always obliged to keep a bold face while in the jungle, so as to set a good example to my native collectors. There is not so much danger from tigers, when one stands erect with a butterfly net in his hand, but when we are stooping, raking in the leaves, we are in great danger." He came down the Malay peninsula (coming overland from Calcutta to Penang), where he was laid up, covered with sores and boils on the soles of his feet, so he could not walk. When he recovered, he went to the island of Java, and from there to Celebes, and

others of the Malayan Islands, catching butterflies all the time and selling enough of these beautiful creatures to pay all expenses. These eastern islands have the famous *Ornithoptera* or bird-winged butterflies, that are not found in any other part of the world. These sell for big prices. December 21, 1887, he went to the great island of Borneo. This was his first trip there, and it was a most unfortunate one; his boxes of implements and supplies went astray, and he never heard of them afterwards. This included his mss. notes for five years, microscope, books, etc., and in addition to this, "my remittances for butterflies sold failed to reach me, and to add to my misery I missed the season for collecting completely. "This wretched year has taken all the youth out of me." He adds: "Mr. Hoze told me not to venture to the interior Dayak villages; that they were cannibals, head hunters, snake eaters and devil worshipers! and that they would abandon their villages if I came there, and they would soon have my head smoking over their fire, that they spoke no Malay, but only a monkey gibberish. In spite of this dire prophecy, I went any way. I found the people kind hearted and honest, though their fear of me was something amusing, but when it wore off we were the best of friends. They do not now hunt heads, and the old ones they had were taken a long time ago, and in fair open battle, whereas in Celebes and even here, up the Barito, it is considered "*comme il faut*" to get one's head on the sly, and women going to draw water and old men too decrepit to fight, are the favorite victims. The language of these Dyaks I can readily understand. I can even understand the little children talking to each other, the severest test of the knowledge of a language. The honesty of these Dyaks is surprising. I go away and leave my bamboo house open and my things scattered over the floor and shelves; and when I return find everything has been examined and inspected by these people, who have visited the house during my absence, but not so much as a pin is missing. Here I am with almost nothing to eat, a little rice porridge and occasionally a scrap of venison dried to a chip over a slow fire. Oh! when I get back to Pengaron won't I get a side of bacon and feast! I have been so weak from this bad diet I can hardly run fast enough to catch butterflies. However, I console myself with the reflection that 'good things

are better than bad things are bad.' I always get enthusiastic when I write or think about beefsteak or pork. I will send this letter down the river by one of the Dyak diamond searchers, who has just found a ten carat-stone. He is going down to Martapura to sell it, and if he makes a good sale, he will not do any more work for a year or so. There are no dangerous animals here in Borneo, quite a relief from certain districts in Java, so terribly infested by tigers." These Dyaks do not seem to resemble those at Sarawak, as described in a book called "Life in the Jungle." "This book, by the way, is a remarkable instance of how little effect education has on literary success. The writer is a showman's assistant. The same year Forbes' book, the work of a polished English gentleman of high scientific attainment, came out, yet Forbes' book is a flat failure, while the other is a model of life-like and interesting narrative. Here in Borneo there are no flowers, and but little life during this wet season to be seen; every thing is obliterated and crushed out of existence by this tremendous mass of green foliage. I measured a leaf of a calladium and it was ten feet long by seven and one-half feet wide, exclusive of the stem." After returning to India and working up the Chittagong and Assam butterflies, Doherty is again in the Malayan Archipelago, and expects to go into the great "terra incognita" for naturalists, the interior of New Guinea, to collect her unknown treasures. He has found hundreds of species of insects entirely new to science, many of which he has described and illustrated with colored plates in Trans-Asiatic Society. The most extraordinary thing about this remarkable trip is, that he has more than paid all his expenses by the sale of his insects. During the present year his sales will amount to $5,000. He numbers among his purchasers some of the most eminent men of science in the world, such as Lord Walsingham, who buys his minute moths; Mr. Bates, who buys his Longicorn beetles; Dr. Standinger, of Germany, who buys large moths and butterflies; Neumoegen, who buys butterflies; T. H. Aldrich, of Cincinnati, who buys his shells, and other specialists, who take the different families. He says, "my beggar-like and dilapidated garb was my safeguard against robbers and thieves, and my running after butterflies was calculated to impress them that I was a harmless lunatic, and so I got through, where a more pretentious

personage might have failed." He collects the butterflies, and after killing them, folds them up in triangular papers, with their fragile and delicate wings folded over the back. When softened and spread they come out in all their exquisite beauty. Naturalists are noted for their enthusiasm, but such perseverance and enthusiastic devotion to the study of nature and her works, in the face of difficulties that would appall most people, is seldom heard of. Doherty has pushed on, under a tropical sun, sometimes in a pestilential climate, stricken down with the deadly fevers and cholera, that are always lurking in those places, some times blinded and covered with sores from bad food and exposure, often with insufficient supplies and almost at the point of starvation, living with savage natives, menaced with the fearful animal pests of these countries, traveling long distances on foot through thorny jungles, yet never deviating from his object, nor tiring in his search, for nearly fourteen of the best years of his life. His is a case unequaled in the history of the many brave and dauntless spirits, who, in the face of almost insurmountable difficulties and hardships, have wrested from nature some of her choicest treasures.

NOTES ON BIRDS.

By Charles Dury and Ralph Kellogg.

This season has been remarkable for the scarcity of many species of birds that are usually common in this locality. The Warblers have been very scarce, and but a single Scarlet Tanager has been seen by either of us. An exception to this scarcity was the occurrence of the Golden-winged Warbler, *H. chrysoptera*, always a rare bird in this locality. Two were taken by Ralph Kellogg May 5th, in an old orchard in Avondale, and seven others were seen in company with Redstarts.

"Bewick's Wren," *Thryothorus bewickii* (Aud.)

April 14, 1891, I shot a male of this wren. It was singing its loud and unwren-like song from the branches of a cherry tree. April 10, 1891, one was taken by Roland Hazen, and May 31 a male was observed building a nest in a box near Mr. Kellogg's house, Avondale. Its mate was never seen. It remained for about ten days and finally disappeared. These are the only ones of this species I have any record of from this locality. In Notes on Birds, by Dury and Freeman, this Journal, there is mention made of two, March 27, 1879.

Orange Crowned Warbler, *Helminthophila celata* (Say).

In the July, 1887, number of this Journal, I recorded the occurrence of this species April 28, 1878. On September 20, R. Kellogg killed, at one shot, one of this and two Tennessee Warblers as they were feeding in company.

"Savannah Sparrow," *Ammodramus savanna* (Wils).

"Sharp-Tailed Finch," *Ammodramus caudacutus* (Gm).

"Swamp Sparrow," *Melospiza georgiana* (Lath).

Specimens of these sparrows taken at Ross Lake, April and May, 1890 and 1891.

"KING BIRD," *Tyrannus carolinensis.*

A male, shot May April 27; had a living beetle in its throat, and from its gizzard another was taken of same species dead, both belonging to the genus *Pomphopœa*, the first of these beetles ever observed here.

"LEAST BITTERN," *Botaurus exilis* (Gm.)

On May 20, 1891, seven of this very pretty little Bittern were taken, five of them males and two females. These birds feed largely on the larvæ of "dragon flies" (*Libellulidæ*) but from the stomach of one a "sunfish," as large as a silver dollar, was taken.

"LITTLE BLACK RAIL," *Porzana jamaicensis* (Gm.)

On May 16, 1891, Mr. Kellogg took another one of these interesting and heretofore rare little rails (in the same locality as the first one). He has very kindly presented it to the Cuvier Club collection. On the 17th of May another was taken at the same place. On May 21 another was taken by David Belding. May 23, Mr. Kellogg secured another, and on the 30th three more—one a female, which was caught by the dog who squeezed an egg, nearly fully developed, from the oviduct. This makes six males and one female, all from the same locality. When the bird is flushed it flies a short distance and alights, it is then almost impossible to flush it a second time.

"CLAPPER RAIL," *Rallus crepitans* (Gm.)

May 1, 1891, while crossing the Suspension Bridge over the Ohio River, Henry Cain observed one of these birds running ahead of him. He captured the bird alive, in good condition, with his hat.

"SNOW GOOSE," *Chen hyperborea nivalis* (Forst.)

A specimen of this species was shot at Ross Lake, April 11, 1891, by Roland Hazen.

MANUAL OF THE PALEONTOLOGY OF THE CINCINNATI GROUP.

By Joseph F. James, M. Sc., F. G. S. A.
(U. S. Geological Survey.)

Part I.

The object in view in preparing the series of papers, of which this is the first, is to present to the students of paleontology of the Ohio valley, in a convenient form, descriptions of the fossils known to occur in the rocks of Lower Silurian age in Southwestern Ohio and the vicinity. The generic and specific descriptions are scattered through many different volumes, and the writer believes the collation and arrangement of them in a compact form will be an assistance and an incentive to the study of paleontology. The present, the first installment, treats of *Plantæ* and *Protozoa*.

PLANTÆ.

ALGÆ.

Under the head of *Fucoids*, which have generally been considered as *Algæ*, a number of species have been described by authors. It is extremely improbable that *Algæ* have left any remains in this formation. An attentive study of the forms described as *Fucoids* shows the larger number to be referable to annelid borings or burrows; or else to be inorganic in origin. Some may be referred to impressions left by certain forms belonging to other classes, and possibly to graptolites. None are, we believe, to be assigned definitely to the class *Algæ*. The forms of inorganic origin will be treated of here. Those referred to other classes will be discussed under each, respectively. (See under Cœlenterata, Hydrozoa, Asteridea, Annelida and Trails.)

Consult in respect to the supposed *Algæ* "Fucoids of the Cincinnati group." This Journal, vol. 7, pp. 124-132, 151-

166, October, 1884, and January, 1885; Dawson's Geological History of Plants; Quart. Jour. Geol. Soc., London, vol. 46, 1890, pp. 595–617; Nicholson & Lydekker's Manual of Paleontology, vol. 2, 1889, pp. 1480–1489.

SPECIES REGARDED AS OF INORGANIC ORIGIN.

Aristophycus ramosum, Miller and Dyer. Contri. to Paleont. No. 2, 1878, p. 4.

Var. *germanum*, M. & D., Ibid. 1878, p. 4.

Both the species and the variety were described as branching stems, the ramifications being sent off without any definite order, and the smaller fibers inosculating like the veins of a leaf. They are both due to the running of water over a muddy bank. Mr. S. A. Miller, in the supplement to his catalogue of Palæozoic Fossils, 1883, acknowledged these forms to be inorganic in origin.

Chloephycus plumosum, Miller and Dyer. Contri. to Paleont. No. 2, 1878, p. 3.

Buthotrephis filciformis, U. P. James. The Paleontologist, 1878, p. 9.

Described as *Algæ* with a main, central stem, and with minor branches jutting out at an angle on either side. Produced by the trickling of water over a bank of sand or mud. Since recognized by the authors as of inorganic origin.

Palæophycus flexuosus, U. P. James. The Paleontologist. 1879, p. 18.

Described as if made of stems flattened by pressure and laid down close to or overlapping and parallel with each other. Really produced by the washing of water along the shore, thus arranging the mud in regular layers. Acknowledged by the author to be inorganic in origin.

Trichophycus sulcatum, Miller and Dyer. Contri. to Paleont. No. 2, 1878, p. 4.

T. venosum, Miller. Jour. Cin. Soc. Nat. Hist., vol. 2, 1879, p. 112.

Described as cylindrical or semi-cylindrical stems with fine hair-like markings upon the rounded, upper surface; the lines diagonal or longitudinal, and more or less irregular. Probably the cast of a depression made in the mud by running water.

MARKINGS OF ORGANISMS.

Dystactophycus mammillanum, Miller & Dyer. (See under CŒLENTERATA.)

Heliophycus stelliforme, Miller & Dyer. (See under ASTERIDEA.

For the following, see under ANNELIDA.

ARTHRARIA ANTIQUATA, Billings. Syn. *A. biclavata*, Miller.

Blastophycus diadematus, Miller & Dyer, as PLANOLITES DIADEMATUM, M. & D. (sp.). Syn. *Trichophycus lanosus*, M. & D., *Saccophycus intortus*, U. P. James.

Buthotrephis ramulosa, Miller as PLANOLITES RAMULOSUS Miller (sp.).

B. succulens Hall as PLANOLITES SUCCULENS Hall (sp.)

Buthotrephis gracilis, var. *crassa*, Hall, as PLANOLITES CRASSA, Hall (sp.).

Licrophycus flabellum, Miller & Dyer as PLANOLITES (?) FLABELLUM, M. & D. (sp.).

Palæophycus radiata, Orton as PLANOLITES RADIATUS, Orton (sp.). Syn. *Dactylophycus quadripartitum*, M. & D., and *D. tridigitatum*, M. & D.

P. rugosum, Hall as PLANOLITES RUGOSA, Hall (sp.).

P. tubulare, Hall as PLANOLITES TUBULARIS, Hall (sp.). Syn. *P. simplex*, Hall.

P. virgatum, Hall, as PLANOLITES VIRGATUM, Hall (sp.).

Rusophycus asperum, Miller, as PLANOLITES ASPERUM, Miller (sp.).

R. subangulatum, Hall, as PLANOLITES SUBANGULATUM, Hall (sp.). Syn. *R. clavatum*, Hall.

SCOLITHUS DELICATULUS, U. P. James.

For the following see under TRAILS.

CRUZIANA (*Rusophycus*) BILOBATA, Hall (sp.).

C. CARLEYI, J. F. James.

C. (*Rusophycus*) PUDICA, Hall (sp.).

Scolithus dispar, U. P. James as EOPHYTON LINNÆANUM, Torell.

Lockeia siliquaria, James, see as DAWSONIA SILIQUARIA, U. P. James (sp.) under HYDROZOA.

Buthotrephis gracilis, Hall, see as DENDROGRAPTUS GRACILLIMUM, Lesqx (sp.). Syn. *Psilophyton*.

RHIZOCARPEÆ.

An order of Heterophyta (Cryptogamia) represented in existing floras by about four genera and fifty species. Mostly aquatic, producing two kinds of spores. Leaves either simple or quadrifid.

SPHENOPHYLLUM, Brongniart. Hist. de Veg. Foss, 1828, p. 68. Lesquereux, Am. Phil. Soc., Proc., vol. 17, 1877, p. 167. Lesquereux, 2d Geol. Sur. Penn. P, Coal Flora, text, vol. 1, 1880, p. 51.

Stem articulate; leaves verticillate, cuneiform, crenulate, dentate or lobed at the apex, which is truncated or rounded; midvein wanting; nerves straight, diverging fan-like, simple at the base, dichotomously forking once or twice.

S. PRIMÆVUM, Lesqx. Am. Phil. Soc. Proc., vol. 17, 1877, p. 167.

Stems or branches slender; articulations close, equidistant; leaves in whorls, each of four or five leaflets, connected toward the base and joined by slightly obtuse sinuses; leaflets either truncate or crenulate at the apex, or sometimes deeply split or lobed; nerves simple at the base, sparingly dichotomous, forking once or simple. The only species of the genus so far known from this group.

Localities.—Covington, Kentucky; Lime-kiln Run, near Cincinnati, Ohio.

LYCOPODIACEÆ.

An order of Heterophyta which, in the existing flora, is small and of little consequence, though of large size in Carboniferous times. It comprises at present only four genera, and from sixty to seventy species. The Club-mosses are the best known living representatives. These are small, low-growing plants, with scale-like leaves and minute spores, produced either in the axils of the leaves or in cone-like bodies

at the ends of the branches. The single genus and species referred to the order here, is problematical. Dr. J. S. Newberry considers it to be doubtfully organic.*

PROTOSTIGMA Lesquereux, Am. Phil. Soc., Proc., vol. 17, 1877, p. 169.

Cylindrical stems with rhomboidal scars. Only a single species known from this horizon.

P. SIGILLARIOIDES Lesqx. Ibid, p. 169.

Branches or stems cylindrical, scarcely flattened by compression; surface marked by rhomboidal cicatrices, enlarged on the sides, contiguous and in spiral order, with indistinct impressions of oval, vascular scars in the center.

(Consult on this species and on land plants in the Silurian in general, Dr. J. S. Newberry, as noted above.)

PROTOZOA.

Animals generally of minute size, composed of a nearly structureless jelly-like substance, (sarcode), showing no composition out of definite parts or segments, having no body-cavity, presenting no traces of a nervous system, and having either no differentiated alimentary apparatus, or but a very rudimentary one.†

Though abundant and of varied form in a living state, species of this group are rare in the older rocks, becoming more numerous, however, as modern times are reached. Though mostly microscopic, some form large communities, and are then readily perceived as a mass, though the individuals remain minute. Several orders are known in both a fossil and a recent state. Only two of them, FORAMINIFERA and SPONGIDA, are known from the Cincinnati group, if we except an anomalous order, STROMATOPOROIDEA, the position of which is still a matter of discussion.

Order FORAMINIFERA.

Structureless, gelatinous, generally minute animals, encased in a calcareous shell, and frequently of considerable size in a fossil state. The shell divided into compartments, the walls

* Am. Jour. Sci., 3d ser., vol. 8, 1874, pp. 110-113.
† Nicholson's Zoology, p. 44

of which are pierced with holes, "foramina." The gelatinous body mass is protruded in the form of filaments from the numerous orifices.

At the present time these organisms are wonderfully abundant. D'Orbigny estimated that an ounce of sand from the Antilles contained 3,800,000 individuals. In past geological time they were equally numerous, in some places forming extensive series of rocks. In the Paris basin 58,000 have been counted in a cubic inch, or 3,000,000,000 in a cubic yard.

At present but one genus is referred to the order, described below. It is placed here upon the authority of Nicholson and Lydekker's Manual of Palæontology, vol. 1, 1889, p. 128.

GIRVANELLIA, Nich. & Ethr., Jr., 1878.

Rounded or oval bodies, composed of "microscopic tubuli, with arenaceous or calcareous (?) walls, flexuous or contorted, circular in section, forming loosely compacted masses. The tubes apparently single cylinders, without perforations in their sides, and destitute of internal partitions or other structures of a similar kind." (Fossils of the Girvan District, 1878, p. 23.)

Remarks.—As synonyms of this genus, as described above, should probably be placed *Strephochetus*, Seely, 1885, and *Streptospongia*, Ulrich, 1889. The following is Seely's description of *Strephochetus*: "A free calcareous sponge, showing in structure concentric layers, composed of minute twining canals." (Am. Jour. Science, 3d ser., vol. 30, p. 357.)

This name was proposed for certain spongoid bodies found in the Chazy rocks of Vermont. Its main character, as given in the meager description, is in the twining canals. In a later paper (Am. Jour. Science, 3d ser., vol. 32, 1886, p. 34), Professor Seely says: "The appearance of the members of the genus may be represented by the smaller fruits, currants, gooseberries and cherries, distributed through a paste of oolitic, fragmental or sub-crystalline material. These, in most cases, have been left in a crushed or torn condition. In weathered specimens they show a concentric structure, more or less regular, which is helpful in distinguishing the genus." This description corresponds exactly with the figures of *Girvanellia*.

Mr. Ulrich's genus, *Streptospongia*, is also founded upon a form with twisted canals. The description says that in trans-

verse section, "the sponge appears composed of labyrinthically intertwining vertical laminæ * * * separated by tortuous and almost linear interspaces, with here and there an irregular angular open space. * * * The vertical fracture shows that this remarkable intertwining is largely produced by connecting processes on the sides of the laminæ." (American Geologist, vol. 3, 1889, p. 244.)

1. G. RICHMONDENSIS, Miller, (sp.) 1882.

Free, globular or sub-spherical, varying in size from two-eighths to seven-eighths of an inch in diameter; consisting of numerous irregularly concentric laminæ, with the inter-lamelar spaces filled in most cases with small twining canals or minute vertical tubes; diameter of canals $\frac{1}{2000}$ of an inch; the vertical tubes have an average diameter of $\frac{1}{500}$ of an inch. When weathered the fossil has the appearance of a *Stromatopora*. (Emended description, Seely, Ibid 1886, p. 32). *Stromatocerium richmondense*, Miller, Jour. Cin. Soc. Nat. Hist., vol. 5, 1882, p. 41; *Strephochetus richmondensis*, Seely, op. cit., 1886.

Localities.—Richmond and Madison, Indiana; Turner's Station, Kentucky.

Remarks.—The emended description by Professor Seely is much better than the original. In the remarks upon it Professor Seely says: "Not unfrequently it occurs as an incrusting body, having for its core a bit of coral, or a fragment of the shell of a brachiopod. * * * The tubes present great uniformity of direction, though not of size. They run nearly parallel with each other for a little distance, and then are cut short by a laminar covering, which may be the basis for a similar set of slightly radiating tubes." (op. cit., p. 33.)

2. G. LABYRINTHICA, Ulrich (sp.), 1889.

Massive, siliceous, about 50 mm. long by 25 mm. wide by 30 mm. high. In vertical section appear labyrinthically intertwining vertical laminæ, about 0.3 mm. thick, separated by tortuous and almost linear interspaces, with an occasional angular open space, 1 mm. in length. (American Geologist, vol 3, 1889, p. 244) *Streptospongia labyrinthica*, Ulrich.

Locality.—Near Lebanon, Kentucky.

Remarks.—This differs from the first described species mainly in form, being massive, instead of oval and free.

Only one fragment of a specimen was used by Mr. Ulrich in his description.

Order Spongida.

One of the lowest orders of animals, consisting of an aggregation of minute beings, together forming a soft mass, with spiculæ of various forms, or having a silicious skeleton filled with sarcode; this sarcode or protoplasm traversed by tubes of varying size, serving to convey nourishment to the individuals of the mass.

As fossils the members of this order sometimes occur as amorphous and irregular masses (this is frequently the case in the Cincinnati group); sometimes the spicules forming the original skeleton are alone preserved; and sometimes the external frame-work is so well preserved that the species can be referred to existing orders or families. Generally it is necessary to study the minute structure by means of microscopic slides to determine the generic relations of the forms. Occasionally species occur in rounded or globular masses, which were evidently free growing, or attached by a single point to the rocks. Some were anchored in the mud by bundles of silicious spicules.

The modern arrangement of fossil sponges is by means of the spicules. In many of the genera found in the Cincinnati group, spicules have not been observed, and consequently any strictly scientific arrangement is not now practicable. That which follows is, therefore, largely, if not wholly, artificial, though it has been the endeavor to group together those genera of which the spicules are known, or which seem to belong together. There have been included in the group two anomalous genera, of uncertain position, viz: *Pasceolus* and *Receptaculites*, while another group, which has sometimes been placed with the sponges, *Stromatoporoidea*, is left for future consideration.

Key to Genera.

a. Free; conical, globular or cylindrical.

† Surface without plates.

1. Astylospongia—Round, unattached, with minute external pores; spiculæ star-shaped.

2. Leptopoterion — Obconical; surface annulated or reticulated.

3. Microspongia—Compact; radiate in structure and without large openings.

4. Hindia—Sphæroidal; a central space with spiculæ; canals opening at the surface.

5. Cylindrocoelia—Cylindrical; pointed or truncate, hollow.

6. Rhombodictyon—Globular or discoid; rods crossing each other nearly at right angles, thus forming rhombic spaces.

†† Surface with plates.

7. Pasceolus—Plates polygonal and without special arrangement.

8. Receptaculites—Plates arranged in intersecting lines; imbricated or cylindrical.

b. Body cavity hollow, sponge cup-shaped or funnel-form.

9. Cyathophycus — Hollow, cylindrical, with a reticulated structure.

10. Chirospongia—Hollow, general form hand-like; structure vesicular.

11. Brachiospongia—Body circular, cup-shaped, with spreading arms.

c. Amorphous.

12. Pattersonia—Irregular in form, generally compressed, and appearing as if a number were united.

13. Dystactospongia—Canals on exterior radiating from a common center.

d. Branching.

14 Heterospongia — Outer surface showing oscula and mouths of canals.

Genus 1.—ASTYLOSPONGIA, Roemer, 1860.

Free, globular or spherical, and nearly circular. The inner tissue made up of very regular stellate bodies (spiculæ) united by their rays. Large canals radiate from the center to the circumference. These cross or are intersected by concentric canals. (Die Silur. fauna des West. Tenn., 1860, pp. 7, 8.)

Remarks.—Two species have been referred to this genus from the Cincinnati group, *A. tumidus*, James, and *A. subrotundus*, James. Neither of these seem to belong to *Astylospongia*. The first seems to be a species of *Pasceolus*, as there are indications of surface plates, and it is referred there provisionally. The second is possibly congeneric with *Hindia* or *Microspongia*. It is referred to the latter genus provisionally.

Genus 2.—LEPTOPOTERION, Ulrich, 1889.

Remarks.—This genus and its type species, *L. mammiferum*, was founded upon a single specimen about three inches high, and a little more than half as wide at the top, and in such a poor state of preservation that, we are told, the "minute details of its structure have been almost obliterated by replacement with iron-pyrites. The outer surface, where best preserved, is finely reticulated, being traversed by lines and series of points ranged in very regular diagonally intersecting, transverse and longitudinal directions." (Am. Geologist, vol. 3, 1889, p. 239). Neither the genus nor the species can be recognized from the description. No figure has, as far as the writer knows, been published. The author of the species may, in the future, have further material to elucidate his species.

Locality.—Roh's Hill, Cincinnati, O.

Genus 3.—MICROSPONGIA, Miller & Dyer, 1878.

"A free calcareous sponge, destitute of an epitheca. The texture is finely porous, without large canals or openings on the surface. Spicules (?) very minute and needle shaped." (Jour. Cin. Soc. Nat. Hist., vol. 1, 1878, p. 37.)

The above is the very unsatisfactory definition of the authors. Nothing has been added to our information in regard to it since the description was published.

1.—M. GREGARIA, Miller & Dyer, 1878.

Small, gregarious, globular and calcareous; free, and without an epitheca. In structure fibrous or minutely porous, compact. Spicules (?) needle shaped. Varying in size from one-eighth to more than one-half an inch in diameter. (Jour. Cin. Soc. Nat. Hist., vol. 1, 1878, p. 37.)

Locality.—Cincinnati.

Remarks.—It is probable that *Hindia parva*, Ulrich, is a synonym for this species. It is described as "free, globular in form, with an even, rounded surface. Specimens vary between 5 and 10 mm. in diameter, but in a large proportion of the specimens seen the diameter varies but little from 7 or 8 mm.

"The radiating canals are a little smaller than in the common *Hindia sphæroidalis* Duncan, of the Niagara, being as a rule not over 0.27 mm. in diameter." (American Geologist, vol. 3, 1889, p. 244). From this description it is impossible to separate the species from *M. gregaria*. Further study may prove it to be distinct.

2.—M. (?) SUBROTUNDUS, U. P. James, 1878.

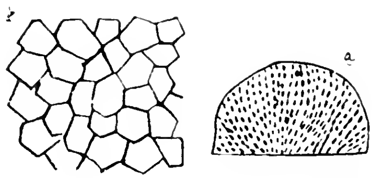


FIG. 1.—*M. (?) subrotundus*, James. *a*. One-half of a specimen showing internal structure: about three times natural size. *b*. Surface features, enlarged.

"Corallum small, free, subrotund. Cut polished sections in different directions show the corallites [canals] as growing from the center of the corallum [mass] outward in every direction and increased by fission. No tabulæ passing *through* the corallites [canals] apparent; they may be found, however, in other examples. Transverse dissepiments between the corallites [canals] strong. Calices unequal in size, some much larger than others, and an average of about eight in the space of a line. In the cut sections the spaces between the dissepiments appear like rows of minute pores, arranged longitudinally between the corallites [canals]." (The Paleontologist, Sept. 14, 1878, p. 11.)

Remarks.—The above is the original description of the species, at that time referred to as *Chætetes subrotundus*, and regarded as a coral. Subsequently (Ibid, June 10, 1881, p. 34,) it was placed under *Astylospongia*, and so regarded as a sponge. The so-called calices apparently radiate from what might be

considered the "poles" toward the "equatorial" region. It is referred to *Microspongia* with doubt, as the minute structure of that genus has not, as far as known, been described.

Localities.—Ogden Station, Clinton County, Ohio. Specimens scarcely to be distinguished from it occur in strata of similar age on Little Maquoketa River, Iowa.

Genus 4—HINDIA, Duncan, 1879.

Free; central space occupied by spicules, soon forming a series of bifurcating, straight, radiating canals, opening at the surface. Spicules calcareous, more or less in form of a stemmed tripod with four limbs, and swollen or fringed at the edges, where junction with others take place. (Annals and Mag. Nat. Hist., 5th ser., vol. 4, 1879, p. 91.)

Remarks.—The only species referred to this genus from the Cincinnati group as yet is *H. parva*, Ulrich. As already stated, that is apparently a synonym for *Microspongia gregaria*.

Genus 5—CYLINDROCŒLIA, Ulrich, 1889.

Free, cylindrical, with the lower end pointed or truncate. Hollow in the sub-cylindrical portion; walls thick, traversed by irregularly disposed, radiating canals; a few penetrate the thin dermal layer on the outer and inner surfaces, and when the dermal layer is worn away, the sub-circular mouths appear. (American Geologist, vol. 1, 1889, pp. 245, 246.)

1.—C. COVINGTONENSIS, Ulrich.

Sub-cylindrical; tapering in a length of 45 mm. from a diameter of 25 mm. to one of 32 mm.; diameter of opening at lower end 6 mm., and at upper 22 mm.; wall varying from 3 mm. to 10 mm. in thickness; canals averaging 1.5 mm. in diameter, with an average of eight in a space 10 mm. square; canals penetrating the wall in an irregular manner. (Ibid, p. 247.)

Locality.—Covington, Kentucky.

Remarks.—This species seems almost entirely based upon size. The diameters of the specimens, the thickness of the walls, and the size of the canals are given with great minuteness. All other features seem to be lacking. Three other species belonging to the genus are described in the volume

quoted, and they are also based mainly upon size. None of them are from the Cincinnati horizon. Probably all the species are fragments of one. They certainly possess few recognizable characters, according to the descriptions.

Genus 6.—RHOMBODICTYON, Whitfield, 1886.

"Globular, discoid or broadly cyathiform fossil bodies, composed of two or more sets of more or less rigid rods or threads, crossing each other at various angles, but not bifurcating or dividing, and leaving rhombic spaces, which are filled with carbonaceous or other substance." (Bull. Am. Mus. Nat. Hist., Central Park, vol. 1, 1886, p. 347.)

Remarks.—Two species and one variety are described by Professor Whitfield, and referred to this genus. Its affinities are stated to be with the Dictyophytons. The following species is as yet the only one recorded from the Cincinnati group:

R. GLOBOSUS, n. sp.

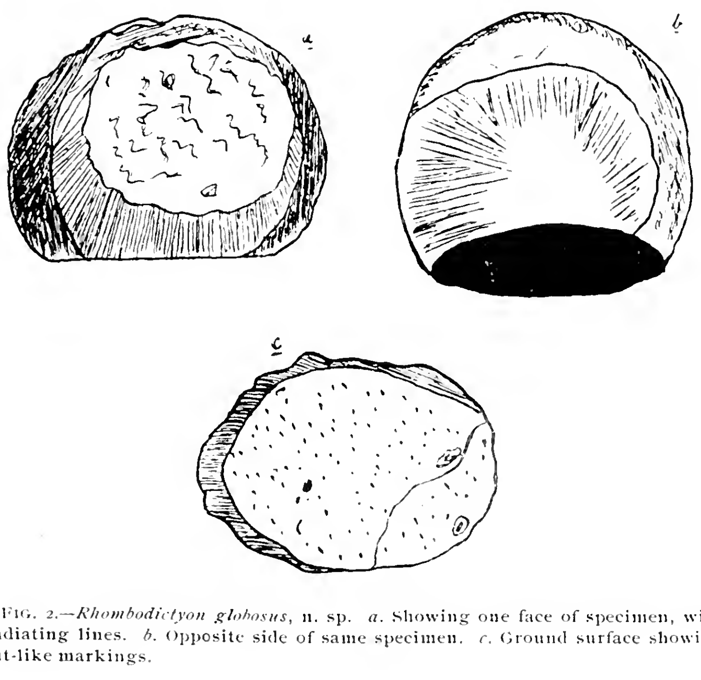


FIG. 2.—*Rhombodictyon globosus*, n. sp. *a*. Showing one face of specimen, with radiating lines. *b*. Opposite side of same specimen. *c*. Ground surface showing pit-like markings.

Sponge body ovoid in form, $1\frac{3}{4} \times 1 \times 1\frac{5}{8}$ inches, the lower portion having been ground off to observe the interior. A series of lines are observable on different parts of the specimen, running parallel with each other, without any seemingly definite starting point, not bifurcating, and in some cases with very fine lines crossing at right angles. Where ground off the specimen shows no structure except numerous small pits, small particles of carbonaceous matter and some irregular lines. Nothing that can be considered spiculæ have been observed, unless the parallel lines be regarded as such.

Locality.—Cincinnati, Ohio.

Remarks.—The specimen upon which this species is founded is in the collection of the late Mr. U. P. James, and was referred by him to "R. discum, Whitfield (?)" It differs from that species in the much larger size and different form. The exact horizon of the specimen is unknown.

Genus 7—PASCEOLUS, Billings, 1857.

Free, ovate or subglobular; exterior surface marked by polygonal plates and with one or more circular apertures; base with or without point of attachment. (Rept. Prog. Geol. Sur., Canada, 1853-'54-'55-'56-'57, p. 342.)

Remarks.—The zoological affinities and position of the genus are uncertain. It has been placed among the Tunicata, the Foraminifera, and in the place here given to it. The probabilities seem in favor of its being one of the Spongida. It was so placed in a previous article, "Protozoa of the Cincinnati Group," by the present writer (Jour. Cin. Soc. Nat. Hist., vol. 9, 1887, p. 248). A similar form, *Cyclocrinus*, was regarded as a Cystidian, and as also one of the Zoantharia.

1. P. GLOBOSUS, Billings, 1857.

Hemispherical or subglobular; two or three inches in diameter, base flattened, plate (?) impressions polygonal, or hexagonal, about two lines in diameter and without external openings (Geol. Sur., Canada, Rept. Prog., 1853-'54-'55-'56-'57, p. 343).

Locality.—Cincinnati, Ohio.

Remarks.—This is mainly a Trenton species, but it has been found in a few localities about Cincinnati.

2. P. DARWINII, Miller, 1874.

Upper half of body hemispherical, about 1¼ inches in diameter, lower half slightly depressed, and with a central, circular depression; the entire outer surface marked by crowded pentagonal and hexagonal depressions, about one line in diameter; frequently compressed and at times covered with a polyzoan; internal structure unknown. (Cin. Quart. Jour. Sci., vol. 1, 1874, pp. 5, 6. *P. claudii*, Miller, 1874. Ibid., pp. 6, 7.)

Localities.—Cincinnati, Ohio, and Maysville, Ky.

Remarks.—The above two species have been generally considered distinct, but the justice of the separation is doubtful. The general shape is the same in both, as are also the condition of preservation and the form of the external markings. *P. globosus* is generally a little the larger; otherwise there is scarcely any difference. *P. claudii* is doubtless the young form. Its description is: "Body spherical, without any depression where the column or pedicle was attached. Entire surface marked by closely crowded pentagonal or hexagonal depressions, about $\frac{1}{30}$ of an inch in diameter. Diameter ½ to ¾ of an inch.

"It differs from *P. darwinii* in size, and in having no depression where the pedicle was attached. It is possible that it might be the young of *P. darwinii*, but at present I think it is a distinct species." It is associated with *P. darwinii* at Maysville, Ky. Later investigations do not seem to have changed Mr. Miller's belief that it forms a distinct species, for it is so regarded in his North American Geology and Palæontology, 1889, p. 162.

3. P. (?) TUMIDUS, U. P. James, 1878.

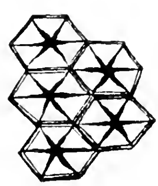


Fig. 3.—*P. ? tumidus*, James. More or less diagrammatic sketch of the plates on upper surface.

"Subglobose, more or less depressed, with a shallow cavity on one side. Surface rough and generally covered with pit-like markings; sometimes quite distinctly lobed; examples examined not very satisfactory," (The Paleontologist, No. 1. July 2, 1878, p. 1.)

The above is the original description. Some specimens examined show a series of hexagonal plates with depressed lines running from the center to the six corners. Owing to the crushed conditions of the specimens, these plates sometimes appear round or oval. Internal structure unknown.

Locality. - Cincinnati, Ohio.

Remarks.—This species was originally described as *Astylospongia tumidus.* It is referred here to *Pasceolus* with a query, since it seems more nearly related to that genus than *Astylospongia.* The form needs fuller investigation.

Genus 8.—Receptaculites, DeFrance, 1827.

"Cup or platter-shaped bodies of considerable size, with walls of definitely arranged spicules. The outer surface is formed by the rhomboidal head plates of the spicules; beneath these are the horizontal rays and robust sub-cylindrical vertical rays, which are connected with an inner layer or perforated plate. Communication with the exterior was carried on between the margins of the summit plates of the spicules on the outer surface, and through the cylindrical canals of the inner surface layer, or, according to Gümbel, through inter-marginal canals." (G. J. Hinde, on Receptacultidæ, Quart. Jour. Geol. Soc., Lond., vol. 40, 1884, p. 826.)

Remarks.—The genus was originally described by DeFrance in 1827 (Dictionnaire des Sciences Naturelles, Tome 45, p. 5). Its position in classification has been a matter of dispute, and it is still very doubtful. Hinde (Ibid) concluded it belonged to the sponges. Billings (Palæozic Fossils, vol. 1, 1865, p. 386) thought its affinities were with Foraminifera; while other writers have considered it a cystidean, a coral or a tunicate mollusk. Nicholson and Lydekker (Manual of Palæontology, vol. II, 1889,) do not consider its position as at all definitely settled. For a full discussion of the family and its affinities, consult Hinde's paper as above, and for details of the structure of the genus, the remarks of Billings, also referred to above.

The genus *Ischadites* is considered distinct by Hinde, but some other authors place it as a synonym.

From the Cincinnati group Mr. E. O. Ulrich has described two genera, *Anomaloides* and *Lepidolites*, which are here considered as congeneric with *Receptaculites*. In order that others may judge, the essential features of the two genera are given below.

Anomaloides, Ulrich, 1878:—Hollow, conical, compressed bodies; composed uniformly of elongated, cylindrical, spine-like bodies, which are placed parallel with each other and perpendicular to the surface. The affinities of the specimens were supposed to be with the Echinodermata. (Jour. Cin. Soc. Nat. Hist., vol. 1, 1878, p. 92.)

Mr. S. A. Miller places the genus with the Echinodermata, and remarks that the word was constructed upon two adjectives, and founded upon a fragment not understood. (N. Am. Geol. & Palæontology, 1889, p. 224). An article among the editorial comments in the American Geologist (vol. 1, 1888, p. 324), says, that to place *Anomaloides* with *Receptaculites* "is simply ridiculous." Had the writer of that paragraph turned to page 381 of Billings's Paleozoic Fossils, volume one, and compared figure 354 with that given on Plate IV., figure 6 *b*. of vol. 1 of the Journal of the Cincinnati Society of Natural History, he would have found some resemblance. Turning to page 380 of Palæozic Fossils, he would have read: "The tubular skeleton [of *Receptaculites*], above alluded to, consists of numerous small, straight, rarely curved, cylindrical tubes, or hollow spicula, placed parallel to each other, and at right angles to the planes of the body wall, of which they form the greater portion." These words are almost exactly those used by Mr. Ulrich in his definition of the genus. The two figures referred to are reproduced below for comparison.

FIG. 4.—*a. Receptaculites* (after Billings). *b. Anomaloides* (after Ulrich). *c.* Two pillars of *Anomaloides*.

Mr. Ulrich's definition of *Lepidolites* is, in substance, as follows: Much flattened, calcareous bodies, sub-spherical, or sub-cylindrical in form. Hollow, with a thin envelope of imbricated plates or scales. The lower (?) end has an indentation, while the corresponding portion of the interior is raised into a small cone. The interior of the sack appears to be lined with a very thin and delicate integument, to the outer surface of which the scales are attached. (Jour. Cin. Soc. Nat. Hist., vol. 2, 1879, pp. 20, 21.)

The writer in the *Geologist* already quoted admits that *Lepidolites* belongs to the *Receptaculitidæ*, but denies it is congeneric with *Receptaculites*. We are inclined to regard it as belonging to the genus as above, considering it likely to be the outer integument, named by Mr. Billings the "ectorhin." In his general remarks upon *Receptaculites* Mr. Billings refers to the form as being discoid, cylindrical, ovate or globular and hollow. "In or near the center of the lower side there is generally to be seen a small rounded protuberance" (p. 379), and from this the plates radiate in curved lines. The "ectorhin" is described as "usually composed of numerous small rhomboidal plates closely fitting together, and arranged in curved rows, which radiate in all directions from the nucleus outwards. * * * It seems probable that, in some of the species, this integument was of a flexible, coriaceous consistence." This description coincides with the features of *Lepidolites*, Ulrich, and we should consider that genus as founded upon an example of the coriaceous membrane referred to by Mr. Billings.

1. R. RETICULATUS, Ulrich, 1878.

Hollow; composed of an aggregation of subcylindrical or club-shaped stems, parallel to each other, and perpendicular to the surface; inner ends acutely pointed; outer ones rounded, and with a minute pit; arranged in curved or flexuous transverse and diagonally intersecting lines. (*Anomaloides reticulatus*, Ul., Jour. Cin. Soc. Nat. Hist., vol. 1, 1878, p. 92.)

Locality.—Covington, Kentucky.

Remarks.—For remarks upon this, see after description of the genus above.

2. R. DICKHAUTI, Ulrich, 1879.

As found, this species was flattened from a subspherical, subpyriform or subcylindrical shape. Integument bearing the plates very thin, $\frac{1}{100}$ of an inch thick, and probably flexible. Plates imbricated, the exposed margin rounded. arranged in concentric lines crossing each other in a quincuncial manner; smaller about the central indented portion, enlarging toward the upper portion. Detached plates cuneiform, the widest end being exposed. (*Lepidolites dickhauti*, Ulrich, Ibid., vol. 2, 1879, p. 21: *L. elongatus*, Ul., Ibid. p. 22.)

Locality.—Covington, Kentucky.

Remarks.—The difference between *L. dickhauti* and *L. elongatus*, is mainly one of size. There does not seem to be enough difference to constitute two species.

3. R. CIRCULARIS, Emmons, 1856.

"This coral is in a form of a thick, flattened ring, studded with circular cells, arranged in regular lines traversing it rather obliquely." (American Geology, part 2, 1856, p. 230.)

Locality.—Lorraine Shales, New York.

Remarks.—The above meager description is scarcely sufficient to enable one to identify the species. The figure given shows a half circle, depressed in the center and elevated toward the rim, with numerous pit-like markings scattered irregular over the surface.

Genus 9. CYATHOPHYCUS, Walcott, 1879.

"Hollow membranous fronds, with an opening at the upper extremity of the frond, elongate or hemispherical in form; reticulate or plain structure" (Trans. Albany Institute, vol. 10, 1879, p. 18).

Remarks.—The above is the original description of the genus. It was, at the time, supposed to be an Alga, but specimens secured at a later date showed it to be a true sponge. This was stated in the Am. Jour. of Science, 3d ser., vol. 22, 1881, pp. 394, 395, where Mr. Walcott says that "the reticulate structure mentioned in the original description was found to be formed of a horizontal and perpendicular series of narrow bands crossing each other at right angles, so as to form a net

work with rectangular interspaces, the narrow bands being formed of thread-like spiculæ resting on, or one against the other. The spiculæ differ in size; some are filiform, while others are stronger and more prominent." The species described by Mr. Walcott are from the Utica, State of New York. That described below as a new species is from rocks of Cincinnati group age.

C. SILURIANA, n. sp.

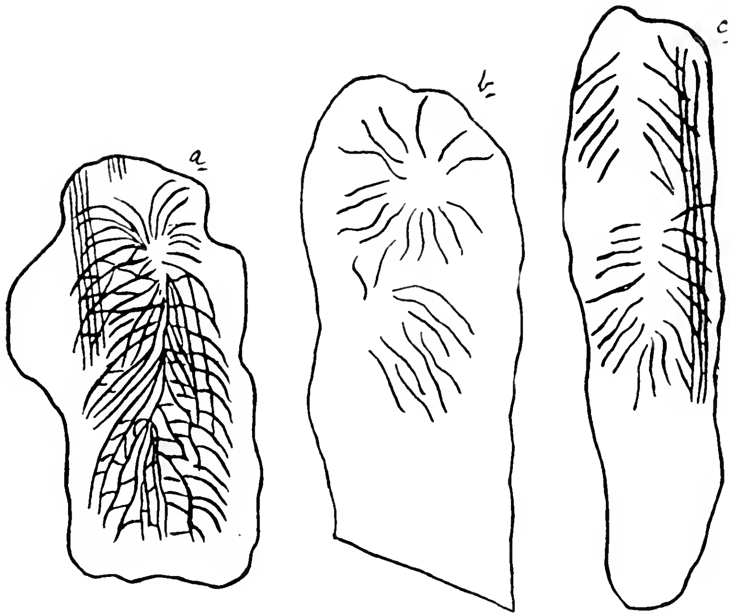


Figure 5. *Cyathophycus siluriana*, n. sp. *a*, type specimen showing the net work formed by cross and perpendicular or oblique lines; *b* and *c* two other specimens not so well preserved.

Rounded or flattened cylindrical bodies, varying from one to two and one-half inches in length, and about one inch in width; outer surface marked by longitudinal lines starting from a common point at one end, and radiating in the form of a cup; numerous transverse lines crossing the longitudinal ones and so forming an irregular net work. The internal structure seems to be entirely lacking, the center being filled with clay, and only a portion of the frame work remains.

Locality.—Cincinnati.

Remarks.—This species is founded upon some specimens in the collection of the late Mr. U. P. James. They had been considered by him as fucoids, but the presence upon the outer surface of well-defined markings has caused them to be referred to the Spongida. Whether the form is congeneric with *Cyathophycus* is perhaps a matter of doubt. But the different state of preservation of the Utica slate species, and this one, may account for the variation. This is preserved in a calcareous matrix, while the others occur in a fine-grained black slate at Utica, New York. The species presents also a resemblance to the forms of *Rauffellia*, Ulrich, 1889.

Genus 9.—Chirospongia, S. A. Miller, 1889.

"General form hand-like, or somewhat like a compressed goblet; composed of internal filamentous or fibrous substance, which is covered with a thin, lobed, vesicular parenchyma." Fastened to the bottom by an expanded base; above, forming a flattened, obconcoidal cup, with deep sulci down each side; hollow; skeleton vesicular or porous; spicules supposed to resemble those of *Brachiospongia*. (N. Am. Geology and Palæontology, 1889, p. 156.)

Remarks.—This is an indefinite and poorly defined genus. The one species from the Cincinnati group referred to it is *C. faberi*, but the type is *C. wenti*, from the Trenton, near Frankfort, Kentucky.

1.—C. faberi, S. A. Miller, 1889.

"This species is founded upon a calcareous fragment of the parenchyma, about one-third of which is shown in the figure [not here given]. It is thin, and belonged to the side of a large, hollow specimen. The semi-elliptical lobes are nearly equal in size, and regularly distributed in rows over the surface. The surface is reticulated with fine papillæ, presenting to the naked eye the appearance of a bryozoum." (Ibid, pp. 156, 157.)

Locality.—Cincinnati, O.

Remarks.—This species, like the genus, is obscure. It was founded upon a fragment, and would be almost impossible to

recognize from either description or figure. Besides the latter is wrongly engraved and would thus mislead the student. No indication whatever is given of the general form of the organism, nor of the presence or absence of spicules. There is scarcely anything that indicates a relationship to the type of the genus, unless it be the lobes, of which, however, no adequate idea can be formed.

Genus 11.—BRACHIOSPONGIA, Marsh, 1867.

"Sponge in the form of a broad cup or vase, with a row of projecting processes or arms around the periphery of the base, and into which the gastral cavity extended. Osculum large, not operculate. Afferent and efferent canal system well developed." (Beecher, C. E., Memoirs Peabody Mus., Yale Univ., vol. 2, 1889, p. 13.)

Remarks.—This genus was first described by O. C. Marsh in Am. Jour. Sci., 2d ser., vol. 44, 1867, p. 68. The description given above is from a monograph of the Brachiospongidæ by Dr. C. E. Beecher. The description of the first species is from the same paper.

1.—B. DIGITATA, Owen (sp.), 1857.

Broad, cup-shaped, or short vasiform, with a row of eight to twelve arms projecting outwards and downwards from periphery of base. Osculum elliptical; below osculum, walls of cup or neck vertical, extending from 25 mm. to 40 mm., and slightly expanding below to origin of arms. Base of cup concave, usually with strong conical or mammiform projec-

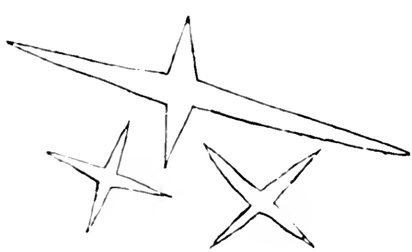


FIG. 6.—*Brachiospongia digitata*, spicules, from inner surface (after Beecher).

tion near the center. Arms nearly circular, extending outward or upward, terminating in a compressed extremity, and when perfect closed at the distal ends. Spicules cruciform. (Beecher, Ibid, pp. 19–20.)

Localities.—Franklin County, Kentucky; (?) Wilmington, Ohio.

Remarks.—This species was first described by Dr. D. D. Owen, in Geol. Sur. of Kentucky, vol. 2, 1857, p. 111, as *Scyphia digitata*. Only one or two specimens in any way perfect have ever been found. One of these is in the State Museum at Frankfort. Excellent illustrations of the species are given in Nettelroth's Kentucky Fossil Shells, and in Beecher's Memoir, above quoted. Mr. E. C. Went, of Frankfort, was fortunate enough to find the fossil *in situ* on Cedar Run, about 2½ miles south of Frankfort, and he has found a large number of fragments, but no perfect specimens. Its horizon is given by Nettelroth as the lower beds of the Cincinnati group, though it has generally been regarded as a Trenton form. Dr. Beecher was the first to describe and figure the spicules, some of which are shown in a figure given above. *B. lyoni* Marsh, *B. roemerana* Marsh and *B. hoveyi* Marsh are synonyms.

A second species of this genus was described by Mr. U. P. James under the name of *B. tuberculata*. (The Paleontologist, No. 4, July, 1879, p. 25). The description is essentially as follows: "Fossil consisting of a sub-circular body with nine arms projecting horizontally somewhat like the spokes of a wagon wheel, and when placed upon its edge has some resemblance to a clumsily constructed, massive wagon-wheel, destitute of tire and felloes. The body is between five and six inches in diameter, one arm broken off close to the body, the others left from one to two inches in length, all having been broken away to such lengths; but the broken, detached end of one was found, which fits closely to the place of fracture, and makes the length of that arm 3½ inches, where it bifurcates; length of *branches* of that arm unknown, both being broken away just beyond the bifurcation. The specimen is about two inches thick through the thickest part of the body, and the arms [are] from 1¼ to 1½ inches in diameter at their junction, tapering very little, if any, to the fractured ends, except where weathered; in fact, the one showing

the bifurcation thickens towards the end, and is two-fifths wider at the bifurcation than where it starts from the body.

"Prominent tubercles, from 1/8 to 1/4 of an inch above the general surface, from 1/4 to 1/2 an inch broad at their bases, and from 1/4 to 1/2 an inch apart at the bases, are distributed irregularly over the surface of the body and arms, also a few pit-like cavities of irregular shapes. One side has, evidently, been exposed to the weather and action of water for some length of time, and become somewhat worn away; on the worn portion the tubercles are all removed. The general surface of the fossil is rough, but with a good magnifier it is difficult to determine whether the roughness may have been caused by pores; the appearance resembles fine papillæ, but I am unable to detect any openings; and the internal structure, at the fractures, seems destitute of any organized arrangement; it is compact and granular-like in appearance."

It differs from *B. digitata*, it is said, in the arms projecting directly outward from the body and in not tapering; and in the possession of tubercles. The locality is given as a branch of Todd's Fork, near Wilmington, Ohio.

I have not been able to see the specimen from which the above description was made. It would seem to be the same as *B. digitata*. Its occurrence in Ohio, if the locality be correctly given, and in beds of the upper portion of the Cincinnati group, is interesting, as it greatly extends the range of the genus in time and in area. Dr. Beecher does not seem to have been aware of this form, and nowhere makes any reference to it.

Genus 12.—Pattersonia, S. A. Miller, 1882.

"A solid, amorphous, calcareous sponge, uniform in structure, vesicular, and destitute of larger canals and openings. Spicules (?)." (Jour. Cin. Soc. Nat. Hist., vol. 5, 1884, p. 43.)

Remarks.—The above is the original description given of the genus. In 1889 Mr. Miller (North American Geology and Palæontology, p. 163) enlarged it as follows: "Solid, amorphous; no large openings; lobed, pendent expansions on the upper surface, and bundles of fine filaments at the base, and in the interior, which do not merge into the parenchyma of the sponge; spicules unknown." It is probable that this genus

and *Chirospongia* are closely allied, if not identical. At all events the genus *Strobilospongia* Beecher, an undoubted synonym of *Pattersonia*, is very similar to *Chirospongia*. The description of Beecher's genus is given below.

Strobilospongia, Beecher, 1889: "Sponge cyathiform or globose with more or less concentric rows of lobes or lobed expansions, on the surface. Anchored to the sea bottom by massive bundles of filamentous spicules (basalia) proceeding from the interior of the base of the cup. The bundle of basalia is well defined at its origin and does not merge into the tissues of the sponge." Spicules cruciform (Memoirs Peabody Mus., Yale University, vol. 2, 1889, p. 14). This differs from the original definition of *Pattersonia*, and is a good supplement to it.

1. P. DIFFICILIS, S. A. Miller, 1882.

"Whether the original form of this sponge was globular or not, we are unable to determine, but as we find it now, it consists of a flattened irregular mass, often appearing as a cluster, but no two specimens having the same form. It is vesicular in structure, and under a magnifying power of 800 diameters, bodies are observed somewhat resembling acicular crystals in the plant *Fuchsia*, and also a few scattering subcircular or subelliptical forms with irregular outlines, which I have been unable to class as spiculæ" (Jour. Cin. Soc. Nat. Hist., vol. 5, 1882, pp. 43, 44).

Locality.—Cincinnati, Ohio.

Remarks.—Nothing has been added to our knowledge of this form since the original description as given above.

2. P. TUBEROSA, Beecher, (sp)., 1889.

Somewhat conical, flattened and deeply indented on opposite sides, from the base to the osculum. Otherwise surface covered with slightly pendent, solid, tuberose extensions of the parenchyma. Summit flattened, osculum irregular, sinuous, margin thin, sometimes convoluted. Base broad, penetrated by mass of basalia or root tuft of anchor spicules. Height from 70 to 80 mm. Spicules cruciform, but very imperfectly preserved (Beecher, 1889, op. cit., p. 26).

Locality.—Turners Station, Kentucky.

Genus 13.—DYSTACTOSPONGIA, S. A. Miller, 1882.

"This is a massive, more or less regularly hemispherical, fixed, calcareous sponge. It possessed a frame work that radiated from one or more points of attachment, and bifurcated without any determinable order, so as to constitute a great part of the body of the sponge. The entire mass is vesicular, the frame work being more dense than the intervening spaces. Spiculæ not ascertained" (Jour. Cin. Soc. Nat. Hist., vol. 5, 1882, p. 42).

Remarks.—Nothing further has been added to our knowledge of this genus.

1. D. INSOLENS, S. A. Miller, 1882.

"Sponge large, irregular, somewhat hemispherical, and varying from two to four or five inches in diameter. The architectural frame work radiates from several different points of attachment, and divides and subdivides without order, and constitutes more than two-thirds of the entire mass. As seen under the higher powers of the microscope, the structure is vesicular throughout, and full of amœba-like outlines which may possibly represent spiculæ * * * * * Under a power of 800 diameters the vesicles are observed to contain numerous subcircular, subelliptical and amœba-like bodies, with irregular outlines, but I am not able to say that they are spiculæ or fragments of such forms."

Locality.—Cincinnati, Ohio.

2. D. MINIMA, Ulrich, 1889.

"Proposed for a small parasitic sponge, apparently congeneric with *D. insolens*, S. A. Miller. It forms thin crusts or small irregular masses upon bryozoa [polyzoa] and other foreign bodies. The largest seen is about 15 mm. wide, and 5 mm. high at the centre. The canals are much smaller than in any of the other species, and the partitions exceedingly thin. About five canals occur in two mm. The whole skeleton is usually replaced by a brown oxide of iron" (American Geologist, vol. 3, 1889, p. 243).

Locality.—Hanover, Butler Co. Ohio.

Remarks.—This species, though parasitic, is considered

congeneric with *Dystactospongia insolens*, regarded as a massive form. The description is meager and vague, and unaccompanied by an illustration. This renders it difficult to recognize the species. Future studies may furnish further information.

Genus 14.—HETEROSPONGIA, Ulrich, 1889.

Sub-lobate, or with irregularly divided, compressed branches. "Entire surface exhibiting the mouths of branching and more or less tortuous canals, which begin near the center, where they are nearly vertical, and proceed toward all portions of the surface in a curved direction. A limited number of 'oscula,' distinguished from the ordinary canals by being larger and surrounded by radiating channels, occasionally present.

"Sponge skeleton between the canals of variable thickness, sometimes appearing nearly solid, at other times composed of loosely interwoven spicule fibers. None of the specimens show the spicules in a satisfactory manner. From the traces seen it would appear that they are mostly very small, and of the three rayed type." (Ibid, pp. 239, 240.)

Remarks.—Mr. Ulrich considers this genus related to the preceding, *Dystactospongia*, remarking that the *four or five species* of Miller's genus known to him are parasitic, or form amorphous masses. But two species of *Dystactospongia* have so far been described.

1.—H. SUBRAMOSA, Ulrich, 1889.

Sub-ramose or palmate; branches more or less flattened, from 9 to 13 mm. thick and from 11 to 30 mm. wide; surface generally even, with irregularly distributed canal apertures; these of varying size, the average diameter being 0.7 mm., with five in five mm.; space between apertures varying from 0.2 mm. to 1.2 mm.; sponge skeleton composed of more or less loosely interwoven fibers, though the interspaces generally appear solid and structureless; spiculæ undetermined. (*H. knotti*, Ulrich, 1889.) (Ibid, pp. 240, 241.)

Locality.—Marion and Lincoln Counties, Kentucky; Cincinnati, Ohio (?), and Spring Valley, Minn. (?).

Remarks.—We have placed *H. knotti* as a synonym of this

species, as there is not sufficient difference between the two to justify a separation. The only essential difference is the occurrence in *H. knotti* of oscula, which are scattered over the surface, these being absent from *H. subramosa*. The imperfect preservation, however, might readily account for the absence of these in the latter species. The canals, too, are smaller in *H. knotti* than in the other. Both occur in the same locality in Kentucky.

2.—H. ASPERA, Ulrich, 1889.

Irregular in growth, "forming thick, shapeless fronds or strongly nodulated, lobate or sub-ramose masses, several inches in length." When well preserved, the surface rough, the spaces between the canals thin and with sharp prominences at intervals; canal apertures irregular, often subquadrate, 0.5 mm. in diameter, with 7 or 8 in 5 mm.; in the nodular examples, canal mouths sometimes disposed in a radial manner, but without oscula at the center of the area; canal apertures sometimes wanting. (Ibid, pp. 241, 442.)

Locality.—Marion and Lincoln Counties, Kentucky.

EXPLANATION OF PLATES.

Plate I.

Fig. 1.—Diagrammatic section of a Lycoperdon, showing the cellulose subgleba and the origin and arrangement of the two sets of threads.

Fig. 2.—Lycoperdon hirtum, Mart.

Fig. 3.—Lycoperdon pulcherrimum, B. & C., with spines enlarged and spores much magnified.

Fig. 4.—Lycoperdon elegans, Morg., with spores magnified.

Fig. 5.—Lycoperdon echinatum, Pen., with spines enlarged.

Fig. 6.—Lycoperdon rimulatum, Peck., with spores.

Fig. 7.—Lycoperdon glabellum, Peck.

Plate II.

Fig. 1.—Lycoperdon separans, Peck., with spores.

Fig. 2.—Lycoperdon pedicellatum, Peck., with spores.

Fig. 3.—Lycoperdon eximium, Morg., with spores.

Fig. 4.—Lycoperdon Curtisii, Berk.

Fig. 5.—Lycoperdon Turneri, E. & E.

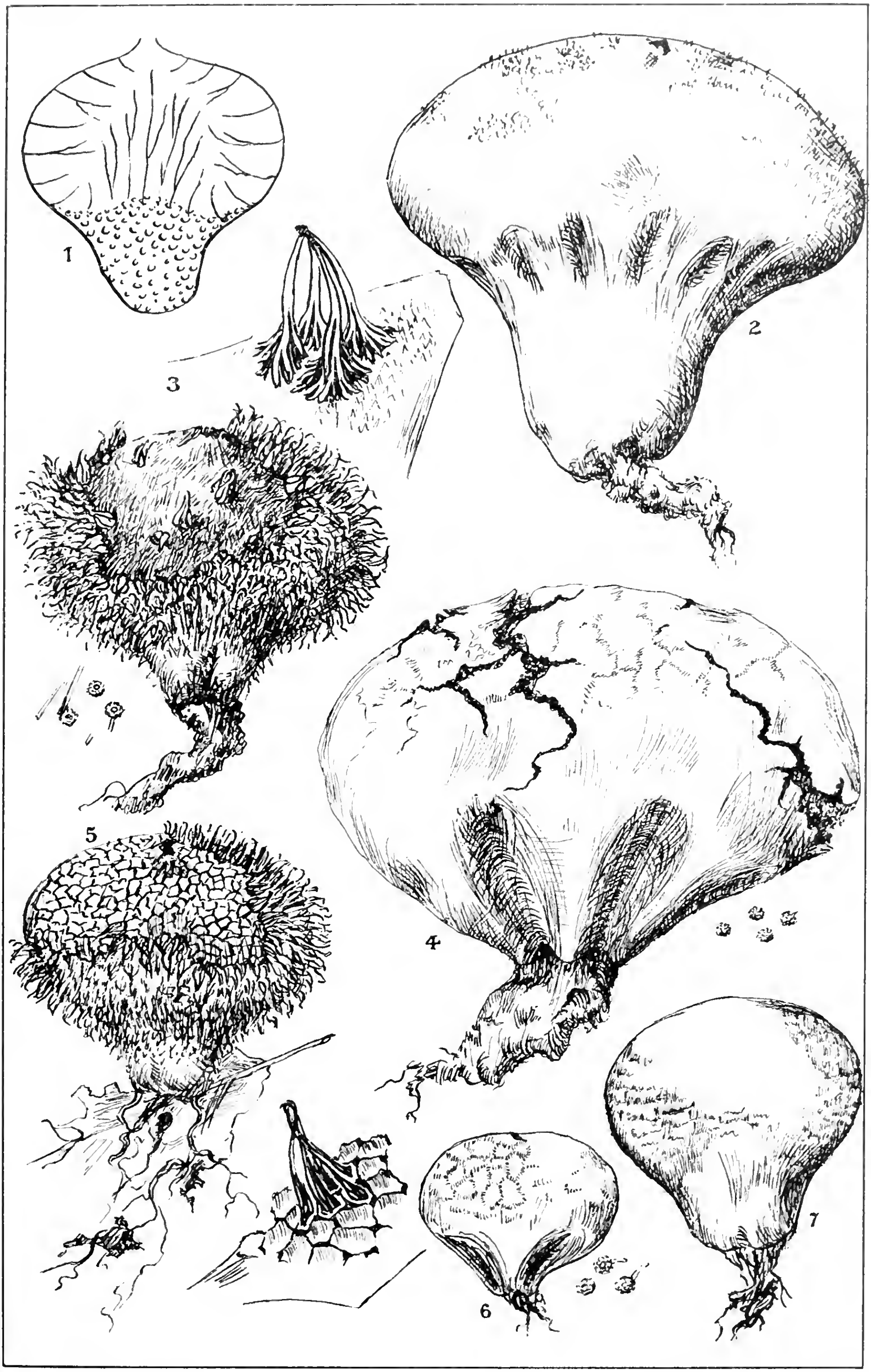
Fig. 6.—Lycoperdon subincarnatum, Peck., with spines and pits magnified.

Fig. 7.—Lycoperdon pusillum, Batsch.

Fig. 8.—Lycoperdon acuminatum, Berk., with spores.

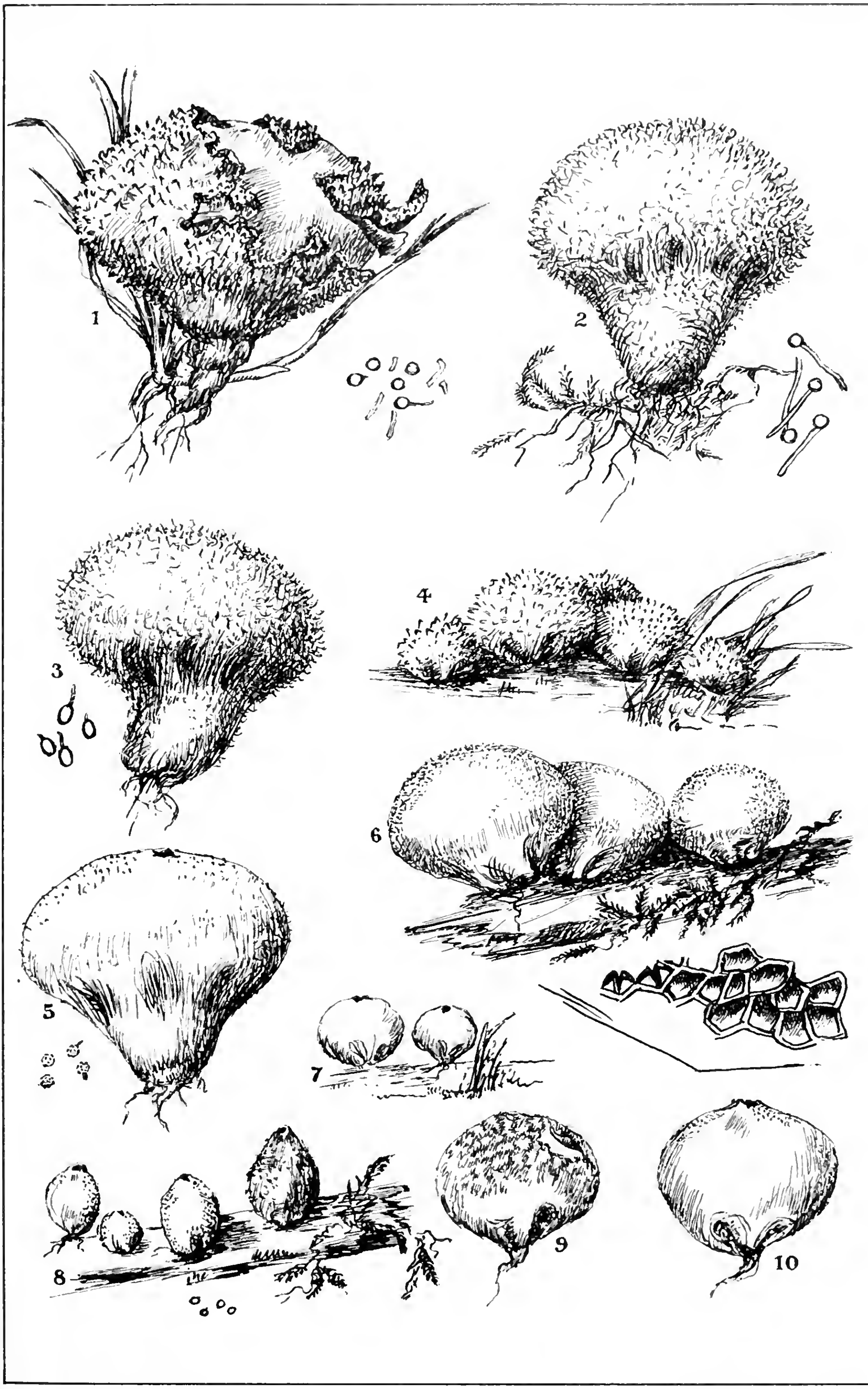
Fig. 9.—Lycoperdon cepæsforme, Bull.

Fig. 10.—Lycoperdon coloratum, Peck.



Laura V. Morgan Del.

THE HENDERSON-ACHERT-KREBS LITH. CO. CINCINNATI



Laura V. Morgan Del.

THE HENDERSON ACHERT-KREBS LITH CO CINCINNATI

The deaths of C. F. Low and S. E. Wright, old members of the Society, were announced, and the resolutions of respect adopted at the informal meeting of March 3, in reference to same, were adopted.

The reports of the Treasurer, Secretary, Librarian, Director of the Museum, and Curator of Photography were read.

Maj. J. Ralston Skinner made a few remarks in reference to the work and progress of the Society and its future.

The election of officers for the ensuing year came next in order, with the following result:

PRESIDENT,	COL. J. W. ABERT.
FIRST VICE-PRESIDENT,	A. DENNISTON SMITH.
SECOND VICE-PRESIDENT,	DR. F. W. LANGDON.
TREASURER,	DAVIS L. JAMES.
SECRETARY,	DR. JAS. A. HENSHALL.
LIBRARIAN,	WM. H. KNIGHT.
TRUSTEE,	WM. P. ANDERSON.

Members of Executive Board at Large.—

ALEX. STARBUCK,	T. B. COLLIER,
T. H. KELLEY,	W. H. KNIGHT.

CURATOR OF GEOLOGY,	E. O. ULRICH.
CURATOR OF BOTANY,	D. L. JAMES.
CURATOR OF ZOOLOGY,	CHAS. DURY.
CURATOR OF ANTHROPOLOGY,	Dr. A. J. HOWE.
CURATOR OF PHOTOGRAPHY,	T. B. COLLIER.
CURATOR OF MICROSCOPY,	DR. B. M. RICKETTS.
CURATOR OF PHYSICS,	W. H. KNIGHT.
CURATOR OF CHEMISTRY,	PROF. K. LANGENBECK.

The President then appointed the Auditing Committee as follows: Geo. Bullock, T. H. Kelley and T. B. Collier.

On motion, the paper of Mr. Chas. Dury on Wm. Doherty was referred to the Publishing Committee.

On motion, the reports of the Secretary and Treasurer were referred to the Auditing Committee.

Adjourned.

REGULAR MEETING, May 5, 1891.

The Society was called to order at 8.15 P. M., President Abert in the chair.

The minutes of the last meeting were read and approved.

The following were proposed for active membership:

Wm. V. Ebersole, Chas. E. Smith, J. Augustus Knapp and Miss Effie V. Ryan.

The report of the Trustees was read by the Secretary, and on motion was referred to the Auditing Committee.

The following resignations were read, and on motion accepted. Miss Lily Hollingshead, Dr. Wm. Owens, Jr., C. J. Stedman, Henry A. Gleick and C. H. Sheen.

The Society listened with decided interest to Dr. M. H. Fletcher's paper on "The Skin and its Appendages" illustrated by photo-micrographs.

Adjourned.

Regular Meeting, June 2, 1891.

The Society was called to order at 8.05 P. M., President Abert in the chair.

There were twenty-six persons present.

The minutes of the last meeting were read and approved.

Chas. E. Smith, Wm. V. Ebersole, J. Augustus Knapp and Miss Effie V. Ryan were elected to active membership.

The minutes of the Executive Board for April were read.

The Auditing Committee reported that, upon examination, the books and accounts of the Treasurer, Secretary and Trustees were found correct.

Upon motion, the report was accepted and the Committee discharged.

Mr. Warren K. Moorehead then read a very interesting paper, entitled "Some Recent Discoveries at Fort Ancient," which was received by the audience with great pleasure, and elicited much favorable comment.

Mr. W. H. Knight then read an instructive and interesting paper on "The Bright Star Arcturus."*

President Abert made some timely remarks on the importance of obtaining a building site for a new museum in Eden Park.

*Published in *Scientific American* Supplement.

Dr. O. D. Norton called attention to a well being bored near Wheeling, W. Va., over 4,000 feet in depth; he also spoke of some fossil bird tracks at an unusual horizon in Massachusetts.

The resignations of Miss Laura J. Frank, Miss Amanda Frank, Dr. J. L. Anderson and William Archer were read and accepted.

Adjourned.

DONATIONS TO JULY 1, 1891.

The Paul Mohr Collection of Minerals, Fossils and Pre-Historic relics, numbering nearly 20,000 specimens, and given to the Society by the following named persons, who subscribed the amounts placed after their names, as follows:

T. H. Aldrich,	$100
Mrs. L. Anderson, Sr.,	50
Eugene Bliss,	25
Julius Balke,	25
Robert Clarke,	50
Julius Dexter,	100
Albert Erkenbrecker,	50
Charles Fleischmann,	100
Julius Freiburg,	25
T. T. Gaff,	50
Gambrinus Stock Co.,	25
H. Goepper & Co.,	50
Chas. Hofer,	100
Kauffman Brewing Co.,	25
Chas. H. Kellogg, Jr.,	100
James Levy & Bro.,	200
C. F. Lunkenheimer,	25
Maddux, Hobart & Co.,	25
Alex. McDonald,	100
Robert Meier,	25
R. Mitchell,	$10
Christ. Moerlein,	100
Joseph R. Peebles' Sons,	10
J. G. Schmidlapp,	200
Mrs. Chas. Schmidlapp,	100
Thos. Sherlock,	100
W. W. Seeley,	50
Albert Schwill & Co.,	50
Ed. Senior,	50
J. R. Skinner,	25
Mr. and Mrs. B. Storer,	50
Volksblatt Co.,	25
James Walsh & Co.,	25
M. Werk,	25
J. L. Workum,	25
Windisch, Muhlhauser & Co.,	50
O. J. Wilson,	100
Paul Mohr,	2,755

Making $5,000, the price asked for the collection.

From Wilbur Dubois: Head of Horned Rabbit, from Edwards, Kansas.

Col. J. W. Abert: 1 specimen Red Granite, Wild Bad., Ger.; 1 specimen Flint, Cherbourg Harbor; 1 specimen Gold Ore (Quartz), Sawyer Mine, Maryland; 1 specimen Gold Ore, Senator Sawyer's Mine, Maryland; 1 specimen Travertine, Heal-

ing Springs, Bach County, Va.; 1 specimen Gold Ore (Pulverized), Dos Cabezas Mine, Arizona; 1 specimen Silver Ore (Pulverized), Silverton, Colorado; 1 specimen Gold Ore, Old Montgomery Mine, Maryland; 1 specimen Feld-spar, Wild Bad., Ger.; 1 Photograph of Col. Abert as a sculptor.

C. E. MacFarlan: A miscellaneous collection of Fossils and Minerals.

Wm. R. Jolly: Unios and Turtles, White River, Ind.

T. H. Aldrich: Photograph of Leaf Insect.

E. O. Hurd: Mallard Duck (Mounted), Tenn.

T. B. Keating: Section of deposit in water pipe, from Walker's Brewery.

Dr. O. D. Norton: 14 specimens of Minerals from Mountain Park, Hot Springs, North Carolina.

Robt. Newlin: Luna Moth

Otto Laist: A collection of fine specimens of Minerals from Lake Superior.

BOOKS AND PAMPHLETS.

From Chas. Schuchert, author: "List of Species of American Palæontology: Orthis, Spirifera, Spiriferina and Syringothyris;" "On Syringothyris Winchell, and its American Species," 1890 (9th Annual Report, New York State Geol.).

E. Dufosse, Paris, Oct. 20, 1890: Americana (Catalogue), Series 7, No. 4.

Hon. Ben. Butterworth: Reports of U. S. Consuls, 1890; Reports of Com. Agriculture for 1887; 4th and 5th Reports Bureau Animal Industry, 1887-88; U. S. Experiment Station Record, November, 1890; U. S. Geol. Report, 1885-86; U. S. Geol. Report, 1886-87, Parts 1 and 2; Report Secretary Interior, Vol. 3, 1886-87; Report Bureau Ethnology, 1884-85; Smithsonian Report, 1887, Parts 1 and 2; U. S. Map of States and Territories; Report National Academy Sciences, 1888; Fruit Culture in Foreign Countries, 1890; Memoirs National Academy of Sciences, Vol. IV., Part 2, 1890; Report of Secretary of Interior, Vol. II., 1890; Smithsonian Report, 1888; Numbers and Values of Farm Animals (Dept. Agric.), 1891; Diseases of the Horse (Bur. An. Ind), 1890; 9th Annual Report of U. S. Geol. Survey; Report of Secretary of War, Pts. 1 and 2, 1889-90.

R. Friedlander & Sohn, Berlin: Catalogue No. 393, Zoologie, 1891.

Board of Elections: Registered Voters of Cincinnati, 1890.

United States State Department: Report International American Conference, 1890.

John C. Branner, author: Address, Relations of the State and National Geol. Surveys, A. A. A. S., 1890.

R. Friedlander & Sohn, Berlin: Catalogue No. 390, Comp. Anat., 1891.

State Board of Health, Tennessee. Bulletin, Nov. 20, 1890.

Yale University: Report, 1889-90.

Miss Mary Magurk: Back Nos. of Journal of Cin. Soc. Nat. Hist.

Dr. A. I. Carson: Report of Bureau Ethnology, 1879-80.

Open Court Pub Co.: The Monist., Oct., 1890.

American Historical Association: Annual Report, 1889.

Amherst College: Catalogue, 1890-91.

United States Census Bulletin: No. 16, 1890.

Dr. J. Rouvier: Revue Internationale Medicine and Pharmacy, Vol. II, No. 4.

Dulau & Co.: Cat., Zool. and Paleon. Works, Pt. XIII., 1891.

Los Angelos Pub. Lib.: Annual Report of Directors, 1890.

Geo. H. Rigby, Phila.: Cat. of Americana, No. 2, 1891.

Dr. O. D. Norton: Cat. Botanical Works, Dulau Co., 1891; Bull. Torrey. Bot. Club, Vol. XVII., No. 9.

Jos. F. James: Vick's Ill. Monthly Guide, Vol. X., 1887.

E. Dufosse, Paris: Cat. Americana, No. 5.

American Ornith. Union: Address of Pres., Nov. 19, 1890.

Wm. Doherty, author: Lycænidæ from Lower Tennasserim.

Ad. De Ceuleneer, author, Brussels: Typ. Indien du Nouveau Monde, etc.

Wm. Wesley & Son, London: Cat. No. 102, Geol., etc., 1890; Cat. Botany, Pts. 1 and 2, 1891; Cat. Conchology, 1891.

James Terry, author: Sculptured Anthropoid Ape Heads, 1891.

Museo Productos Argentinos: Ano. III., No. 31, Buenos Ayres, 1890.

Jacob D. Cox, author: The New Apochromatic Objective, 1890; Deformed Diatoms: Coscinodisceæ. Pamphlets.

Brooklyn Institute: Year Book, 1889-90.

H. F. Koehler, Leipzig: Cat. No. 500, Exacte Wissenschaften, Cat. No. 502, Botanik.

J. S. Newberry, author: Flora of Great Coal Falls, Montana; The Genus Sphenophyllum.

S. A. Miller, author: Description of Subcarboniferous Crinoids from Missouri; *Exchange*, Jour. Linnean Soc. of Botany, Vol. VIII.; Jour. Linnean Soc. Zoology, Vol. VIII.; Trans. Linnean Soc., Vol. XXIV.

Dr. E. G. Betty, author: Critical Examination of the Teeth of Several Nations.

Florentino Ameghino, author: Revista Argentina de Historia Natural, Tomo I., No. 1.

Tenn. State Board of Health: Bulletin, March, 1891.

Dulau & Co., London: Cat. Botanical Works, 1891.

Miss Annie Laws: Pro. Am. Ass. for Advancement of Science, 1881 to 1890, inclusive.

Department of Agriculture: Report of Secretary, 1890.

U. S. Fish Com.: Bulletin, Vol. VIII., 1888.

Miss Amelia Merrill: Back numbers of Journal of Cin. Soc. of Nat. Hist.

Department of Interior: Five Monographs, as follows: Vol. I., Lake Bonneville, G. K. Gilbert, 1890; Vol. XIII., Geol. of the Quicksilver Deposits of the Pacific Slope, by Geo. F. Bicker, 1888, with accompanying atlas; Vol. XIV., Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and the Connecticut Valley, by John S. Newberry, 1888; Vol. XV., The Potomac or Younger Mesozoic Flora, by William Morris Fontaine, Parts 1 and 2, 1889; Vol. XVI., The Paleozoic Fishes of North America, by John Strong Newberry, 1889; Mineral Resources of United States, 1887-1888, by David T. Day, and 24 Bulletins, Nos. 41 to 64, inclusive.

D. C. Bellville: Horned Toad.

Geo. L. Talley: Stag Beetle.

Frank Lukens: Samia cecropia.

REPORT OF TREASURER, CINCINNATI SOCIETY OF NATURAL HISTORY, FOR THE YEAR ENDING APRIL 6, 1891.

Receipts from all sources,	$9,575 21
Payments,	9,218 06
Balance in Treasury,	$357 15

RECEIPTS.

Balance,	$174 48
Dues and Initiations,	1,283 89
Interest,	2,283 80
Five Per Cent Bonds sold,	1,800 00
Six Per Cent Bonds sold,	1,200 00
Amount of Building Fund received from Trustees,	1,762 54
Life Memberships,	950 00
Donations to Building Fund,	105 00
Refunder—W. B. Carpenter & Co.,	8 65
Sales of Journal,	6 85
	$9,575 21

PAYMENTS.

Salaries and Wages,	$1,665 14
Fuel, etc.,	74 30
Treasurer's expenses,	5 94
*Printing, etc.,	285 19
Custodian's Sundries,	194 47
Binding,	15 00
Gas and Water,	39 99
†Insurance, five years on Collection and New Building,	261 00
‡Journal,	727 87
Repairs,	38 70
Museum,	87 40
Dues refunded (paid twice),	9 00
‖Building,	5,814 06
	$9,218 06
Balance,	357 15
	$9,575 21

*This item includes some bills for Sundries.

†Insurance for $10,000 on Collection and $3,000 on New Building.

‡Includes item of $82.18 carried over from previous year.

‖For detail of payments, see accompanying paper marked *A*.

A—PAYMENTS ON ACCOUNT OF BUILDING.

Surveying Lot, A. S. Hobby,	$15 00
Architect's Plans,	80 00
Architect's Superintendence,	80 00
Henry Behrens, Contractor,	4,671 35
John Story, Plumbing and Gas Fitting,	460 61
Bennett & Peck Heating and Ventilating Co.,	359 60
Electric Fixtures,	127 75
Stained Glass and Sundries,	19 75
	$5,814 06

BUILDING FUND.

Derived from the following sources.

Life Memberships,	$950 00
Building Fund,	1,762 54
Five Per Cent Bonds,	1,800 00
Six Per Cent Bonds,	1,200 00
Donations,	105 00
	$5,817 54
Balance,	3 48

During the year just ended the collection of dues and initiations has been in the hands of the Secretary, who has made returns of amounts collected from time to time.

A greater part of the bills paid have been by order drawn on the Treasurer, by the Secretary, and countersigned by the President. The exception to this rule was made by special resolution of the Executive Board, authorizing the Treasurer to pay gas and water bills, and salaries as they became due, without any special action of the Board. The Executive Board also authorized the Treasurer to make payments on account of the building to the contractor on certificate of the architect.

The vouchers accompanying this report, therefore, consist of: Orders drawn by Secretary, gas and water bills, receipts for salaries and wages, architect's certificates.

A complete list of vouchers will be prepared and submitted wi'h the vouchers to the Auditing Committee.

The Treasurer takes pleasure in reporting that the interest on the Endowment Funds of the Society has been fully and in most cases promptly paid.

It is not inappropriate in this report to allude to the long services of my predecessor in office, who has so lately passed to his long reward. The value of the service performed for the Society by Mr. S. E. Wright, during the many years of his term as Treasurer, can hardly be realized by those unfamiliar with the details of his work. The care with which the accounts were kept scarcely appears in his reports, complete and systematic as they are. The duties incident to the office are much lessened by the present system of collecting dues and paying bills. To the former duty, during Mr. Wright's term, was added the care of the Endowment Fund.

Mr. Wright's system of accounts has simplified greatly the work of the present Treasurer, and he wishes to record his obligation to him ; and also to add his tribute to the memory of a firm and true friend of the Cincinnati Society of Natural History.

All of which is respectfully submitted,

DAVIS L. JAMES,
Treasurer.

The undersigned committee, to whom has been referred the Report of the Treasurer of the Society of Natural History for the year ending April 6, 1891, beg leave to report that they have carefully examined the books and vouchers exhibited to them by the Treasurer in connection with said report, and find the report in all respects correct and true.

Very respectfully submitted,

GEORGE BULLOCK,
T. B. COLLIER,
T. H. KELLEY,
Committee.

Cincinnati, May 18, 1891.

REPORT OF THE SECRETARY.

CINCINNATI, O., APRIL 7, 1891.

TO THE PRESIDENT AND MEMBERS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

In accordance with the requirements of the Constitution I have the honor to submit the following report :

During the past year there have been held nine regular and one informal meetings—there being no quorum present at the July, August or March meetings, owing to unfavorable weather. The average attendence at meetings was thirty.

There were read in full, by abstract or by title, eighteen papers on scientific subjects, some of which have been published in our "JOURNAL."

During the past year there have been elected forty-six active members, one honorary and one corresponding member, and fourteen active members have resigned. Three active members, one life member and one honorary member have died. Twenty members have taken life memberships.

We have, at present, nearly three hundred members.

During the year I have collected and paid to the Treasurer:

Dues from Active Members, ...	$1,205 00
Dues from Life Members, ...	1,000 00
From Donations to Building Fund, ...	100 00
From Subscription and Sale of Journal, ...	6 00
Total, ...	$2,311 00

The Tenth Annual Course of Free Popular Scientific Lectures was given in our New Auditorium, with an average attendance of two hundred persons. The entire expense of the course was but $30 50. The lecturers were Prof. J. G. Porter, Dr. F. W. Langdon, Prof. C. L. Herrick, Prof. Karl Langenbeck, Dr. Jno. E. Baker, Mr. Chas. Dury, Dr. David S. Jordan, Dr. Joseph Ransohoff and Dr. J. A. Henshall, all of whom gave their services gratuitously.

During the year I have issued Certificates of Membership to all members in good standing.

I have had the Society's building placed upon the free-water list by the Board of Public Affairs.

The correspondence of the Society during the year has been quite extensive, and our standing as a scientific institution is paramount to any other west of the Alleghany Mountains.

We have added a new addition 30x60 feet, and three stories in height, furnishing an Auditorium, a Library, rooms for the Photographic Section, and a Museum room nearly 30x60 feet, lighted by sky-lights. Respectfully,

J. A. HENSHALL, *Secretary.*

REPORT OF LIBRARIAN.

To the Cincinnati Society of Natural History:

The plans for the enlargement of the Society's building during the past year embraced special accommodations for the library, which is now located in a well-lighted room, on the second floor, and jointly occupied as a reading-room by the Photographic Section.

In this room our volumes are arranged on the shelves of ten large book-cases, each provided with glazed double doors. In addition to these there are three similar cases in the Secretary's room, on the first floor. The latter are occupied principally by unbound pamphlets, exchanges and the latest reports.

Our library, at the present date, consists of 2,409 bound volumes and about 1,800 pamphlets and exchanges. The bound volumes comprise valuable works of reference in general science, comprehensive reports of National and State surveys, and monographs and elaborate treatises on special subjects.

The following departments of science are fairly well represented, namely: Geology, including paleontology and mineralogy; chemistry, physics and microscopy; botany and forestry; zoology, including conchology, ichthyology, entomology and ornithology; anthropology, ethnography and archæology.

The quarterly Journal, published by our Society, containing, as it does, a report of the Society's proceedings, and the most important scientific papers contributed by its members, is highly appreciated by scientists in both hemispheres, and secures for us a large and valuable exchange list. These exchanges number one hundred and sixty-eight, of which eighty, or nearly one-half, are American, and the remainder come from scientific associations in Europe, Asia, Africa, Australia and South America.

It has been the custom of our Society to bind from forty to fifty volumes of exchanges and pamphlets each year, but, owing to a diversion of the Society's funds to building purposes during the past year, no additional volumes have been bound, and there is a considerable accumulation of very im-

portant scientific material that is not in a convenient, and scarcely in an accessible, shape for reference.

As these latest exchanges and pamphlets bring the researches of science quite down to date, they are of great importance to scientific students and the working members of our Society, and at least one hundred volumes should be bound and made accessible to use at once.

Though we have quite a respectable library, as compared with many other scientific associations in this country, yet we occupy a very modest place beside some of the older organizations in the East. I may cite two or three of them, by way of comparison:

The Franklin Institute, located in Philadelphia, has 35,015 bound volumes and 20,972 pamphlets.

The Academy of Natural Sciences, of Philadelphia, has 30,831 bound volumes and 8,621 pamphlets.

The Essex Institute, in Salem, Mass., has about 50,000 bound volumes and upwards of 100,000 pamphlets.

It will thus be seen that our library is comparatively small, and we shall gladly welcome additions of scientific works from whatever source, and thankfully acknowledge the donations.

In conclusion, I desire to call the attention of those intelligent members of our Society, who have no special scientific aims or tastes, to the large amount of really interesting material stowed away, in one form or another, upon the shelves of our library.

There are spirited sketches and artistic views, in well-written and finely illustrated explorations and surveys, and there are graphic descriptions of curious animal, vegetable and mineral forms to be found in odd nooks and corners of the earth, and there are presentations of some branches of natural science in a style so attractive as to have the fascination of romance.

It will pay you well to search out some of these precious gems, partially buried in the dry and forbidding technicalities of science, and read the thrilling story of nature, as told by such masters as Herschel, Lyell and Tyndall, Darwin, Wallace and Huxley, Humboldt and Helmholtz, Arago and Flammarion, Agassiz, Gray and Newcomb, and the host of other brilliant writers on various branches of natural science.

WM. H. KNIGHT, *Librarian.*

REPORT OF DIRECTOR OF MUSEUM.

CINCINNATI, April 7, 1891.

TO THE PRESIDENT AND MEMBERS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

As Director of the Museum, I have the honor to report as follows:

Immediately after the last Annual Meeting the collections from the old rear building were moved into the main building, preparatory to re-building that portion. I was forced to place these additional collections wherever room could be found for them, without any attempt at orderly arrangement, as the main building was greatly over-crowded before. During the building operations the Museum was closed to the public, for ostensible reasons.

The Museum still remains in a crowded and chaotic state, as nothing can be done in the direction of an orderly arrangement or classification until new cases are provided for the new room in the third story of the addition. This, it is hoped, we will soon be able to accomplish, when our valuable collections can be properly, orderly and scientifically displayed.

During the year we have had donated to the Society the large and valuable collection known as the Paul Mohr Collection, and estimated to be worth $10,000, containing, as it does, some 20,000 specimens of fossils, minerals and pre-historic relics. It is one of the finest representative collections in the country.

The following are the names of the donors:

J. G. Schmidlapp, Julius Dexter, Alex. McDonald, Jas. Levy & Bro., Chas H. Kellogg, Jr., Christ. Moerlein, Chas. Fleishmann, Charles Hofer, Thos. Sherlock, Herman Goepper & Co., Thos. T. Gaff, Dr. W. W. Seeley, Albert Schwill & Co., Edw. Senior, Robt. Clarke, Mrs. C. L. Anderson, Windisch, Muhlhauser Co., Albert Erkenbrecker, E. F. Bliss, Maddux, Hobart & Co., Jno. Kauffman Brewing Co., Gambrinus Stock Co., C. F. Lunkenheimer, Mrs. Bellamy Storer, Cin. Volksblatt Co., Mrs. Chas. Schmidlapp, James Walsh & Co., J. Ralston Skinner, Robt. Mitchell, Jos. S. Peebles & Co., O. J. Wilson, T. H. Aldrich, Robt. Meier, Julius Frieburg, J. L. Workum, M Werk, J. A. Henshall.

We have also received during the year, among other donations, a large collection of Marine Invertetrates, from the United States Fish Commission, at my personal solicitation; also from the same source a collection of Florida fishes, being a portion of a collection made by me in the Winter of 1888–89. (These are not yet unpacked).

I have also added ten new species of Ohio fishes, so that our collection of Ohio fish fauna is now nearly complete, there being but about twenty more known species to procure, having altogether one hundred and thirty species.

The collections of birds has been added to by Mr. E. O. Hurd, and the mammals by Mr. Chas. Dury.

Prof. G. Brown Goode, Director of the United States National Museum and Assistant Secretary Smithsonian Institution, visited our rooms twice during the last few months, and stated that he considered our Society the center of scientific interest west of the mountains, and as having, by far, the best Museum. In a recent letter to me he says: "The constant activity of your Society, and the amount of work which it is accomplishing, is quite sufficient to justify the construction of another building, when the scope of its energies and the work which it will be in a position to accomplish, will doubtless be very greatly extended."

We hope in the near future to secure a site in Eden Park, removed from the smoke and soot of the city, and to erect a fire-proof building for our Museum. Our present building should always be retained for offices, the Library, for lectures and meetings, and for the Photographic Section.

Respectfully,

J. A. Henshall,

Director.

REPORT OF CURATOR OF PHOTOGRAPHY.

Cincinnati, April 7, 1891.

Mr. President, Ladies and Gentlemen:

On behalf of the members of the Photographic Section of this Society, I have the honor and pleasure of reporting that this section is in a very prosperous condition. Our member-

ship has increased in the last year from 127 to 150. We have lost no members by death, and but fifteen by resignation.

Our annual excursion, given on Decoration Day, May 30th, of last year, was attended by about 100 members of this section, and was greatly enjoyed, both socially and photographically, and proved a financial success.

The exhibition of lantern slides, which has been given annually by this section, was given this year by a few members in their individual capacity, so there could be no question raised as to whether there was a violation of the constitution of the Society, in charging an admission fee, although such charge was made solely to raise a fund for the purpose of defraying part of the expense incurred by this section in fitting up their quarters. This meeting was very largely attended, although the weather was most inclement, and was very gratifying to the members, as showing, beyond doubt, that there was no lack of interest by the public in the work of the members.

In the same line with this, is the series of lectures now in progress, one of which was given in this building a week ago last Thursday evening, to be followed on next Thursday evening by another, and again in two weeks from that date by the final lecture.

Our equipment, which a year ago was very incomplete and in a primitive condition, so far as apparatus for practicing photography was concerned, has been replaced with new and modern appliances; four dark-rooms added, which, with our studio, reception and reading-rooms, are the equal of those owned by any society in this country. All this has been done without any assistance from the Society at large, except for those additions which form a part of the permanent addition to the Society building. Such furniture as the chandeliers in both the reception and reading-rooms, the carpets, curtains and photographic apparatus of all kinds, including the gas fixtures in the auditorium, have been paid for by members of this section alone. In addition thereto, this section has furnished the auditorium with 200 very handsome and comfortable chairs, and has assumed the payment for same. This latter is not really a debt which should have been incurred by the section, for it benefits the Society at large quite as much,

if not more, than it does the section, and the payment of same was assumed by the section in the hope and with the belief that the Society would appreciate the efforts which the section was making to render the auditorium attractive and comfortable, by responding liberally to the invitations to attend the series of lectures which the section has prepared for the express purpose of raising a fund to pay for the refurnishing of the auditorium. In this, I regret to say, the section has been disappointed, as very few of the members of the Society of Natural History, outside of the members of the Photographic Section and its friends, have responded to the invitations sent out. Further than this, and in the matter of raising money to pay for the additions and improvements made on this building during the past year, the Photographic Section has responded very nobly. No less than nineteen of its members have taken life memberships in the Society, and have either taken for themselves, or by personal solicitation have induced their friends, who otherwise would not have done so, to purchase notes issued by this Society in the sum of $2,100.

Mention of these facts is made, Mr. President, not for the purpose of lauding the action of the members of this section, but to correct an impression which, I am informed, exists in the minds of certain members of the Society, who are not members of this section, that this section is not in accord with the Society, but is a drag upon the Society. This, I am sure, is a misconception. This section is as loyal to the Society as any of its other branches are, and has evidenced its loyalty by causing to be paid into the treasury of the Society, either by its members, or through their individual friends, including their annual dues, the sum of $3,700. This is more than any other section of this Society has done, and as much, I believe, as all the other sections put together have done.

Very respectfully submitted,

T. B. Collier.

TRUSTEES' REPORT.

CINCINNATI, OHIO, April 27th, 1891.

TO THE BOARD OF DIRECTORS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

Gentlemen—Absence from the city prevented the presentation of your Trustees' report at the last annual meeting of the Society. Accordingly, that report for the Trustees, to date, is herewith transmitted.

The securities, notes and bonds, in possession of the Trustees, are described as follows:

MORTGAGES SECURED BY REAL ESTATE.

FROM	Date	Time	Interest	Par Value
Martin Byrnes,	April 22, 1887,	1 year,	6 per cent,	$4,000
W. S. Baker and Wife,	May 9, 1888,	3 years,	7 "	1,500
Caroline Blymyer et al,	Nov. 23, 1887,	2 "	6½ "	8,000
Anthony Costello,	Sept. 19, 1887,	3 "	6 "	1,000
Mary S. Orange,	Dec. 23, 1880,	3 "	6 "	2,000
Richard Oliver,	Aug. 18, 1887,	3 "	6 "	3,000
John A. Bigelow,	Aug. 31, 1889,	2 "	6 "	1,000
William M. Este,	Oct. 14, 1889,	1 year,	6 "	4,000
Joseph M. Story,	Nov. 30, 1889,	3 years,	6 "	1,000
William M. Este,	Nov. 25, 1889,	2 "	6 "	8,500
Margaret A. Shields,	Dec. 3, 1889,	3 "	6 "	4,000
Total,				$38,000

BONDS AND OTHER SECURITIES.

Cincinnati Southern Railway Bonds, $7\frac{3}{10}$ per cent,	$2,000
Note of A. A. Ferris, dated July 26th, 1890, payable on demand, interest 6 per cent, (held by Davis L. James, Treasurer), amount,	600
One Cincinnati Deficiency Bond, 4 per cent,	500
" " " " 4 "	100
Total Bonds, etc.,	$3,200

RECAPITULATION.

Mortgage Securities,	$38,000
Bonds and other securities,	3,200
Total funds on hand (face value),	$41,200

It will be observed that there has been no change in the mortgage securities since the report of a year ago. Some of these mortgages are past due, but, following the rule in vogue for a number of years, we allow mortgages to run after due, where the security remains unimpaired, and the interest is paid promptly. These requirements have been complied with, and therefore the mortgages remain the same.

In June of last year the Treasurer of the Society made demand upon the Trustees for what is known as the Building Fund. From inquiry of the former Treasurer and examination, it was found the funds in the hands of the Trustees included a specified fund or sum of money which had been known as the Building Fund, and was not properly a part of the general funds of the Society. This had been included in the general fund, and had been invested with the other funds of the Society, and was, therefore, entitled to interest. This Building Fund, upon calculation of interest, amounted, on June 23d, 1890, to the sum of $1,762.54. To provide this fund, it was necessary to convert some of the Society's securities into money. The Trustees accordingly disposed of the U. S. 4 per cent bonds, par value, $2,000, at 122¼, altogether amounting to $2,445. Out of this sum the Trustees paid over to the Treasurer, Mr. James, the amount of the Building Fund, as above stated. This left several hundred dollars on hand for investment.

Mr. Ferris, one of the Trustees, said to Mr. James, that he could use $600, and would pay interest on the amount; and accordingly he gave a note for that amount, payable on demand, which is in the hands of Mr. James, the Treasurer.

The note of Miss Emily Orange for $540, appearing in our report of a year ago, has been recently paid, and the proceeds of that note and the other surplus money on hand have been invested in the Deficiency Bonds, above noted.

The bond for $500 was purchased at 102¾, and the $100-bond was purchased at 105¾.

The Trustees will exhibit their accounts and securities to the Board, or a committee that may be appointed, at any time agreeable to the wishes of the Board.

Respectfully submitted,

AARON A. FERRIS, }
W. P. ANDERSON, } *Trustees.*

The undersigned committee, appointed to audit the foregoing report of the Trustees of the Society's funds, beg leave to report that they have examined the securities in the hands of said Trustees, and find that they have been accurately described and listed, and that the said report is, in all respects, a correct statement of the financial condition of the Society.

Very respectfully submitted,

GEORGE BULLOCK,
T. B. COLLIER,
T. H. KELLEY,
Committee.

CINCINNATI, May 18, 1891.

ON THE AGE OF THE PT. PLEASANT, OHIO, BEDS.*

By Prof. Joseph F. James, M. Sc., F. G. S. A.
(Ass't Geologist, U. S. Geological Survey.)

The rocky strata in the vicinity of Cincinnati have been observed and studied for many years and by many persons. It is probable that even the very early settlers noticed the rocks exposed in the hills, and used them for the foundations of their houses. The hill slopes could not have presented the same aspect they now have, for the easily disintergrated rock and shale must have formed a regular slope with few, if any, rocky ledges projecting. The streams between the hills probably exposed the character of the formation; and it could not have been many years before the main features of the strata were shown. Not only were practical men attracted to the rocks, but as time passed students came from various parts of the world to see and collect the fossils so abundant in the vicinity. The locality now has a world-wide reputation as a spot abounding in wonderfully preserved organic rocks.

A mere list of the authors who have written upon the rocks and fossils of Cincinnati and its vicinity would be a long one. It would include the greater number of the early geologists of our own country, and not a few of those from abroad. As far back as 1815 Dr. Daniel Drake, in his "Picture of Cincinnati," described, in a general way, the characters of the rocks, noting that they were in layers from one to eighteen inches thick, the limestone alternating with clay or slate. He also mentioned various fossil corals and shells that had been found, but gave no definite description of them.

In 1818 the same writer published another paper entitled "Geological Account of the Valley of the Ohio,"† in which he

*Published by permission of the Director of the U. S. Geological Survey.
†Am. Phil. Soc. Trans., new ser., vol. 2, 1818, pages 124-139.

describes the limestone as nearly horizontal; and he gives also the details of a section across the river from Cincinnati to Newport, illustrating it by a colored plate.

In 1829 Vanuxem called attention to the resemblance the strata of parts of Ohio, Kentucky and Tennessee bore to rocks occuring at Trenton Falls, New York,* concluding from the fossils that the rocks of the East and of the West were of approximately the same age. This is the first direct correlation made of the strata about Cincinnati with those of New York. But it was not the last, for since that time many others have instituted similar comparisons. A few of these will be here referred to.

In 1841 Conrad mentioned the limestone of Cincinnati as the "equivalent or continuation of the black limestone of Trenton Falls,"† the correlation being based upon the fossil contents of the rocks.

In the following year Hall stated‡ that there was at Newport, Kentucky, opposite Cincinnati, a green shale occupying the same position, and containing the same fossils as the Utica Shale of New York; saying also that the rock below it, "which is seen in place only during low water in the Ohio," is probably the equivalent of the Trenton limestone of New York. This correlation is made upon stratigraphical position.

Previous to this, and to Conrad's correlation mentioned above, Prof. John Locke‖ had given an admirable description of the blue limestone of southwestern Ohio, stating that it was found as far south as Lexington, Kentucky, but that at Frankfort, the Cliff limestone was found. The latter is now known to be of Trenton and not of Niagara age, as Dr. Locke supposed. No comparison was made by him with rocks in the eastern States.

In 1843 Hall published a paper§ in which he examined the structure of the rocks along a line from Cleveland to the Mississippi River, in the course of which he referred to the strata in the vicinity of Cincinnati, and other localities in Ohio and

*Am. Jour. Sci., vol. 16, 1829, page 256.

†Fifth Annual Report Geol. Sur. of New York, 1841, page 27.

‡Am. Jour. Sci., vol. 42, 1842, page 61.

‖Second Ann. Rept. Geol. Sur. Ohio, 1838, page 207.

§Trans. Am. Asso. Geol. and Nat., 1843, pages 267–293.

Kentucky. A study of the rocks at Maysville, and of the fossils contained therein, led him to refer them to the Hudson River Group of New York. He said that neither the character of the rocks nor the fossils indicate the Trenton Group. He described a section as seen at Cincinnati, and concluded upon the evidence of *Triarthrus beckii* and fossils in the overlying rocks, that the Utica slate was represented; and that although a lower rock was exposed, it might or might not be the Trenton. He then describes the overlying series forming the main mass at Cincinnati, concluding that they represent the Hudson River Group. The remains of *Isotelus* (*Asaphus*) had usually been considered sufficient proof of the identity of the Cincinnati rocks with those of Trenton age in New York, but Hall said that all the specimens he had seen were different from Trenton forms. "So that," he continues, "although certain species of the genus do occur in the Trenton limestone and are characteristic of that formation, others are not necessarily so, and unless we take wide ranges in our groupings, we can not depend on generic types In this case the amount of evidence seems to be about equally divided between the Trenton and Hudson River Groups; but since there are fossils decidedly typical of the latter, and we know that in New York they never occur in a lower position, we are compelled to admit that this formation is of the same geological age."*

In all the subsequent publications of Prof. Hall, this term has been applied to the rocks of this age in the Mississippi Valley. He has been followed by most of the writers who have referred to the rocks up to the year 1865. In this year Meek and Worthen proposed† the name "Cincinnati Group" to cover the strata of Ohio and other western States, previously referred to the "Hudson River Group." The term "Cincinnati Group" has, since its proposal, been generally used, especially by western geologists, as they recognized it as a convenient and applicable term. Its employment has, however, always been resisted by Hall and some others, who continue to use Hudson River and Utica Shale. We are not now concerned with the application of any special term, being

*Ibid, page 276.

†Phil. Acad. Nat. Sci. Proc., vol. 17, 1865, page 155.

inclined to accept Mr. C. D. Walcott's suggestion to refer to these rocks as the Cincinnati shale and limestone in the Hudson Terrane.*

Upon the organization of the Second Geological Survey of Ohio, under Dr. J. S. Newberry, special attention was naturally directed to the rocks in the vicinity of Cincinnati, and in the first volume of the final report,† Prof. Edw. Orton proposed to divide the rocks into three series as follows:

Lebanon Beds,	293 feet.
Cincinnati Beds, proper,	425 "
Point Pleasant Beds,	50 "
Total,	768 feet.

The Cincinnati Beds are again divided into the—

Hill Quarry Beds,	125 feet.
Eden Shales,	250 "
River Quarry Beds,	50 "
Total,	425 feet.

Details are given of these different series, together with an account of the fossils obtained from various strata.

It is to the lowest division of the Cincinnati rocks, called by Prof. Orton the Point Pleasant Beds that particular attention is directed at the present time. This series is stated to contain the lowest rocks of the State, and it takes its name from the exposure at Point Pleasant, a little settlement on the Ohio, some twenty-five miles above Cincinnati. The beds of the series begin at low water mark at Cincinnati, and descend gradually toward the east as far as Point Pleasant, when they rise again. At this point the strata are about fifty feet in thickness, below the lowest level of the Cincinnati rocks. They have been described by Prof. Orton as being lighter in color than the upper courses, and to be sometimes slaty in structure, "while in others they have a tendency to assume lenticular forms of concretionary origin, sometimes to such an extent as to destroy their value as building rock. The layers

*Value of the term Hudson River Group in Geologic Nomenclature. Bull. Geol. Soc. of Am., vol. 1, 1890, page 353.

†Geology, vol. 1, 1873 page 373.

are also exceptionally heavy, attaining a thickness of sixteen or eighteen inches, and are often so free from fossils as to afford no indication of the kinds of life from which they were derived."* It was this series that was subsequently referred to the Trenton horizon by S. A. Miller, of Cincinnati, and Prof. Orton, the State Geologist of Ohio; and it was also visited and studied by the writer of this last year, under the auspices of the United States Geological Survey. It will be interesting to refer still further to the literature before detailing the results of my own examination.

The first volume of the Geology of Ohio, cited above, was severely critised by Mr. S. A. Miller, in a paper read before the Cincinnati Society of Natural History in August, and published in the *Cincinnati Enquirer* of August 7, 1873. The author states that he had examined the rocks at Point Pleasant, and all the exposures on the river as far as Cincinnati; and that there were neither lithological nor paleontological characters to distinguish this series from that exposed at Cincinnati. He advocated discarding Prof. Orton's designation, considering it "wholly unwarranted," and a "drag upon the science." He thought the rocks represented a lower horizon than those of Cincinnati, but did not consider them any more worthy of a special name than "every exposure at each sepaate hill throughout the blue limestone region." He also criticised the division into *River Quarry Beds*, *Eden Shales* and *Hill Quarry Beds*, believing there were no facts to warrant any such division. Throughout the article, neither the names Hudson River nor Trenton, as applied to any of the Ohio rocks, appear.

This opinion was materially modified about six years later in a report of a committee of which Mr. Miller was Chairman.†

The committee was appointed to report upon some system of nomenclature for the Cincinnati rocks, and they referred the strata to the Utica and Hudson River Groups, stating also that probably the Trenton is represented in the banks of the Ohio River, "a few miles east of the city." This refers doubtless to the rocks at Point Pleasant. It is a return to the

*Ibid, pages 373-374.
†Jour. Cin. Soc. Nat. Hist., vol. 1, 1879, pages 193-194.

opinion expressed by Prof. Hall in 1842.* This report has been quite extensively quoted, and it has been erroneously considered to represent the views of the majority of the Cincinnati geologists. It was criticised by Mr. U. P. James in 1879,† who, after giving the evidence adduced in favor of referring the rocks to the Hudson River and the Utica Slate, says that if the name "Cincinnati" be dropped, "it would seem more appropriate to take the Trenton Group, *not* Utica Slate, nor Hudson River; the proportion of Trenton fossils in the Cincinnati being more than *two* to *one* of the Utica Slate or Hudson River." He was not, however, in favor of using Trenton, but of retaining the term Cincinnati, basing his argument on the fact that only about one hundred out of the five hundred species known from the Cincinnati Rocks, are identical with species from either the Trenton, Utica or Hudson rocks of New York; and out of the one hundred, sixty-five are confined to the Trenton, eighteen to the Utica and Hudson, and the remainder are common to all three groups.

In 1882 Mr. W. M. Linney,‡ of the Kentucky Geological Survey, said that the building stone quarried at Point Pleasant, Ohio, was doubtless the same as the gray limestone forming the upper part of the Trenton of New York.

In 1882 Prof. Edw. Orton|| changed his reference of the Point Pleasant Beds from the Cincinnati Group to the Trenton, thus following Miller. The reference was made from the fact that the Utica Shale was found to be three hundred feet thick at Findlay, Ohio, and contained the characteristic fossil, *Leptobolus lepis;* and this shale having disappeared from the lower part of the State, the Hudson rocks must rest directly upon the Trenton Group, which thus became exposed at Point Pleasant. But this fact does not agree with the statement made on page 300 of the same volume, that the Hudson River

*It is noteworthy that of the members of the committee reporting thus, two of the five, who have since written upon the subject, have returned to the use of the term "Cincinnati Group;" and this, too, within a year after the adoption of the report. These two are A. G. Wetherby and E. O. Ulrich. Messrs. Miller, Dyer and Mickleborough still adhere to Hudson River and Utica Slate. As far as known to the writer, the other five have not published any papers dealing with the subject.

†The Paleontologist, No. 4, pages 27-28.

‡Notes on rocks of Central Kentucky, 1882, page 6.

||Geol. Sur. of Ohio, vol 6, 1888, page 5.

Group is one hundred and twenty-four feet, and the Utica shale one hundred and thirty-five feet thick at Cincinnati, below which comes the Trenton limestone. This statement is based upon the record of a well bored at Cincinnati. Now, the mouth of this well was only about seventy feet above low water in the Ohio River; of this seventy feet, forty-eight were drift materials, leaving twenty-two feet of rock down to low water. Deducting this from the thickness assigned to the Hudson River Rocks we find it extending one hundred feet below low water in the Ohio; and if to this we add the one hundred and thirty-five feet assigned to the Utica Shale, we have two hundred and thirty-five feet of rock below low water in the Ohio, at Cincinnati, before the Trenton limestone is touched. How, then, is it possible upon this evidence to assign the beds at Point Pleasant, only fifty feet lower than the lowest rocks at Cincinnati, to the Trenton terrane? In a second well, it is estimated that the Trenton was reached at a depth of about two hundred and fifty feet below low water in the Ohio River.

In the same year, 1888, Mr. E. O. Ulrich, in an article entitled "A Correlation of the Lower Silurian Horizons of Tennessee, and of the Ohio and Mississippi Valleys, with those of New York and Canada,"* mentions the Point Pleasant Beds and assigns them to the lower part of the Cincinnati rocks. On another page of the article,† he correlates the beds with rocks occurring at Lexington, Kentucky.

In 1889 Prof. Orton, in the course of a paper on "The Trenton Limestone as a Source of Petroleum and Natural Gas in Ohio and Indiana,"‡ again refers to the Point Pleasant Beds as of Trenton age. He says this reference was made in 1873 by some geologists, among them Mr. S. A. Miller, citing the JOURNAL OF THE CINCINNATI SOCIETY OF NATURAL HISTORY. This date is an obvious error for 1879, because the first volume of the JOURNAL was not issued until 1878–1879, and in January, 1879, the report of the committee already alluded to was published. No special description of the strata is given, but mention is made of the composition of the limestone, and it is compared with the Trenton of other localities.||

*American Geologist, vol. 1, 1888, page 307.

†Ibid, page 181.

‡Eighth Ann. Rept. U. S. Geol. Sur., part 2, 1889 page 546.

||Ibid, pages 550–552.

In 1890 the same reference is again made by Prof. Orton,* but no details beyond those already mentioned are given.

The references above given comprise some of those that have been made to the rocks of Cincinnati, and they are all, we believe, that have considered the Trenton to occur in outcrop in Ohio. In order to study the section at Point Pleasant, I visited it last year (1890) and secured the data given below. A careful study of the fossils collected, and of other localities in the neighborhood, will add something to the account here given, but it is not believed the conclusions will be materially modified. The section studied is in the bed of a small stream that heads near the top of the hill. It is situated about half a mile below the village of Point Pleasant, and two openings have been made in the hill near the wagon road, about fifty feet from the water's edge.

SECTION AT POINT PLEASANT, OHIO.

	Feet	In.
Hill slope (covered)		--
Limestone, with a few thin bands of shale, . . .	10	
Shale, with occasional thin layers of limestone, . . .	37	-

Trinucleus concentricus was found in a limestone layer overlying a layer containing mud cracks.

	Feet	In.
Limestone, with occasional beds of shale, ...	30	4

There are two very decidedly waved layers in this distance of 30 feet 4 inches. One is near the top and the other near the bottom. In the latter, the distance from crest to crest of the waves was 4 feet 6 inches. This layer was largely made up of crinoid stems.

	Feet	In.
Heavy bed of limestone, ...	2	—

This course is remarkable for its compactness, thickness and extent. It contains many fossils, such as branching species of Monticulipora, Strophomena, etc. It is plainly visible about midway in the quarry opening on either side of the ravine, and it is a marked feature in the quarries along the road between New Richmond and Point Pleasant. In one of these quarries a great mass had fallen down, more or less concretionary

* First Ann. Report Geol. Sur. Ohio (third organization), 1890, page 12.

	Feet	In.
in its structure, portions peeled off having a conchoidal fracture. The fossils observed in the ravine were also visible in this large mass.		
Covered,	6	4
Limestone and shale,	5	8

A heavy layer of limestone about 8 inches thick occurs about a foot from the top, underlain by a foot of shale. The rest is limestone in broken courses.

Limestone and shale,	5	8

This interval contains waved limestone layers and 4 beds of shale, 10 inches, 8 inches, 10 inches and 6 inches thick respectively. The limestone contains quantities of corals, brachiopods, and fragments of *Asaphus*. In one of the layers, *Strophomena alternata*, *Monticulipora mamillata* and stems of *Glyptocrinus* occur. Fig. 1, pl. 3, shows the character of the strata in this section.

Limestone and shale,	5	8

In this series the limestone is in broken courses of varying thickness, and with a few thin seams of shale. It forms a series of steps in the stream bed. On the bank, about midway, is a large slab of rock 1 foot 8 inches thick, 3 feet 10 inches wide and 4 feet 10 inches long, upon the surface of which were specimens of *Strophomena alternata*, *Orthoceras* with septa ¼ of an inch wide, *Orthis*, *Zygospira* and a *Murchisonia* like *M. gracilis*. Fig. 2, pl. 3, shows the character of the section, with the large slab of rock on the bank at the right.

Limestone and shale,	1	6

The limestone is in thin courses, and more or less waved. The shale lies between broken courses below and a heavy waved course above, formed of finely comminuted material. The top forms the approximate bottom of the quarry opening on the eastern side of the ravine.

Limestone,	1	6
Concealed,	20	—

It is impossible to give the character of this portion

of the section, as it is covered by heavy stone set on end to form a culvert under the road. About 6 feet from the top, however, a heavy waved layer of limestone was seen. From about this point down are the 50 feet which have been called the Point Pleasant Beds, or the Trenton of some authors. In the beds of other ravines, in one in particular about a mile to the westward, is an extensive bed of shale, not slaty, however, and apparently destitute of organic remains. This, in fact, is the case with all the shale beds of the region. While the limestone layers are generally full of fossils, the shale beds are barren. Above this point limestone predominates; below it the limestones and shales are in about equal proportions.

	Feet.	In.
Shale and limestone, ...	11	4

This interval is also largely concealed, being covered by debris brought by the stream from above or washed out of the banks on either side. The shale alternates with the limestone in courses. The slabs in the stream bed are covered with fragments of brachiopods, crinoid stems, etc. Corals are also abundant, particularly in the upper portion. *Asaphus*, *Strophomena*, various forms of Gasteropoda and *Orthoceras* also occur. One layer of limestone 2 feet 3 inches thick, lies in three courses, and is largely made up of finely comminuted fossils.

	Feet.	In.
Limestone and shale, the former with a few obscure and irregular "fucoidal" markings, ...	1	3
Limestone, compact and unlike most of the layers in being unfossiliferous; it breaks across the bedding into oblong, rectangular blocks shaped like scythe stones, but on an enlarged scale, ...		2
Yellow shale, ...	1	2
Limestone, forming a waved layer above, and separated from an uneven lower course by yellow shale. The upper layer is formed of fragments of crinoids, brachiopods, etc., ...	1	9
Blue and yellow shale, ...	1	4

This contains a thin layer of limestone, with species of *Orthis*, *Asaphus*, *Calymene*, *Leptæna sericea*, etc., mostly (except the last) in a fragmentary condition.

	Feet.	In
Limestone, more or less waved and formed of fragments of Brachiopoda, *Asaphus*, *Monticulipora*, etc. These last are all branching or parasitic, ...		6
Yellow shale, ...		6
Limestone, ...		2
Blue shale, ...		7
Limestone and shale, ...	1	4

The shale is largely covered by debris, but the limestone is well exposed, and is markedly waved, the distance between crest and crest of the undulations being 3 feet 6 inches, and the depth of the hollow about 6 in. The rock is formed of finely comminuted fragments of crinoids, *Asaphus*, *Orthis*, etc., and contains specimens of *Strophomena* and *Ptilodictya falciformis* (?)

Limestone and shale, the former seamed and broken, . .	—	6
Limestone and shale, ...	1	—

The shale has nodules in it containing specimens of *Orthis testudinaria* or *O. jugosa*. The limestone is made up of countless fragments of crinoid stems, and with what appear to be basis of crinoids or of species of *Ptilodictya*. *Monticulipora*, *Orthoceras*, *Asaphus*, etc., also occur.

Limestone, very uneven in its bedding, ...	—	4
Shale, ...	—	3
Limestone, in a compact layer, underlain by a seam of blue shale, ...	—	2
Covered, ...	11	6
Total, ...	189	6

Section cut off by river.

The lower portion of the section below the top of the supposed Point Pleasant Beds has been given in considerable detail, to determine, if possible, whether there were any features of the rocks different from those ordinarily seen in the rocks at the base of the Cincinnati section. None were observed. The section is a continuous succession of shales and limestones, the latter sometimes in heavy, and again in thin, courses. The heavy layers are not specially prevalent in the lowest 50 feet; indeed, the heaviest layer is over 80 feet above the river. There is no break in the deposition, unless it be in the 20 feet now covered, and no marked change in the characters presented.

As far as present information goes, there seems to be no more reason for assigning the Point Pleasant Beds to the Trenton, than there would be in making a similar disposition of the lowest beds at Cincinnati.

During the same season a visit was made to Ludlow, Kentucky, opposite Cincinnati, where the lowest beds of the vicinity are exposed. The water was higher than it had been when Point Pleasant was visited, but from previous knowledge I can say that the rocks exposed even at extreme low water, do not differ materially from those seen on this visit. Nor do they differ from the lower strata at Point Pleasant, except in being more extensively exposed. One section having a vertical height of from 25 to 30 feet was seen in the bed of a small run, and the two views on plate 4 show the character of the exposure from bottom to top. There are alternations of limestone and shale, some of the former being quite heavy, from 8 to 12 inches thick, and conspicuously waved. They are also covered with inorganic or the so-called "fucoidal" markings.

The conclusion is reached, after a study of the Point Pleasant section, and a comparison with the lowest layers as seen on the Ohio at Ludlow, Kentucky, that there are neither lithological, paleontological, nor sedimentary characters, by which to place the two series in two different terranes, unless an arbitrary line be drawn between them; and while there is and can be no question as to the existence of the Trenton limestone beneath a large part of the State of Ohio, there is no good reason to say that it outcrops at the surface in any locality within her borders.

A LIST OF THE BIRDS OF WARREN COUNTY, OHIO.

WITH A SUPPLEMENTARY LIST OF BIRDS OF PROBABLE OCCURRENCE.

RAYMOND W. SMITH.

(Read by title, January 6, 1891.)

The County of Warren is situated in the south-western part of Ohio. Its southern border is but twenty miles north of Cincinnati, while its western border is about the same distance from the Indiana State line. For all practical purposes of description, it is a square, twenty miles on the side. Across its north-western corner flows the Great Miami, which, with its tributaries, the most important of which are Clear Creek and Shaker Creek, drains the north-western and western part of the county. But the main drainage valley and the county's great artery of bird migration is that of the Little Miami River, which flows directly through it from northeast to southwest, receiving, as comparatively important tributaries, Turtle Creek on the north, Cæsar's Creek on the east, and Todd's Fork on the southeast. The two rivers and the numerous creeks have all cut deep valleys, so that the surface of the country is much diversified.

When first settled, in the latter part of the last century, the entire county was covered by forests, but these have been cleared away, until at the present time cultivated land exceeds by several times the area of woodland. With the clearing of the land has come the drainage, to a large extent, of a great tract of wet, swampy woodland in the western part of the county, the once extensive "Shaker Swamps" being now reduced to a comparatively limited area. All this change must have had an effect upon the avian fauna of the county, but there is no record of it to which to refer.

But another change in the geographical features of the county is of sufficiently recent date to be a matter of both record and memory. Until a few years ago there were two

comparatively large bodies of water in the county one, the Lebanon Reservoir, originally built as a feeder to the Lebanon and Middletown Canal, situated just north of the town of Lebanon; the other, what was known as Shaker Pond, located about five miles due west of Lebanon. But about eight years ago, during a rainy Summer, both the reservoir and the pond burst their banks. The former was repaired, but broke down its walls again the same year, since which time the county has been without anything in the way of large bodies of water. For a number of years previous to their destruction both were used as the supplies of mill races, and in dry seasons the water, becoming very low, would leave exposed large banks of black alluvium, which attracted great numbers of wading birds. Then again, each Spring and Fall, both the reservoir and pond were the regular stopping places of many varieties of water-fowl. So the destruction of the two little artificial lakes has resulted in the changing of many birds (mainly, however, of those included in the orders Pygopodes, Longipennes, Anseres, Paludicolæ and Limicolæ) as far as this county is concerned, from regular and common Spring and Fall migrants to rare migrants, and even rare and irregular visitants; and some birds, formerly not uncommon, have since been observed very seldom or not at all.

The following list is very largely the result of personal observation. An important factor, however, has been a handsome collection of mounted birds, prepared by Mr. J. F. Gould, then of this place, now of Cincinnati, in 1879 and the Spring of 1880, all of which were taken in the immediate vicinity of Lebanon. Facts concerning the few birds now extinct in the county, have been furnished by the older residents. But the large portion of the list has been worked out single-handed, and represents the results of odd hours and holidays of several otherwise busy years, and about four months of steady observation and collecting in the Winter and Spring of 1890. It is by no means perfect or complete, as the large list of "Birds of Probable Occurrence" shows for itself; and the above-mentioned rather limited opportunities must serve as an excuse for the omission from the list proper of a number of species which careful observation will certainly demonstrate to occur in the county.

In the following pages the A. O. U. nomenclature has been followed as a standard, and as to the common or vernacular names, the Code is also followed in most cases, the exceptions being birds well-known in the county by the names which appear in the list, rather than those given in the Code. The dates of arrival and departure, which are necessarily approximate, are given so as to include all but the very early or late stragglers.

CLASS AVES.

SUB-ORDER CARINATÆ.—Carinate Birds.

ORDER PYGOPODES.—Diving Birds.

FAMILY PODICIPIDÆ. Grebes.

1. COLYMBUS AURITIS Linn.—Horned grebe. Rare Spring and Fall migrant. A pair in the collection of Mr. Gould was shot on the old reservoir in April, 1880.

2. PODILYMBUS PODICEPS (Linn.) — Dipper; pied-billed grebe. Regular Spring and Fall migrant, by no means as common now as in the days of the reservoir, on which "dippers" were abundant during the Spring and Fall months, and a few remained during the Summer and probably bred.

FAMILY URINATORIDÆ.—Loons.

3. URINATOR IMBER (Gunn.) — Loon. Spring and Fall migrant, now quite rare. At times, however, as many as fifteen and twenty have been seen at once on the Lebanon Reservoir.

ORDER LONGIPENNES.—Long-winged Swimmers.

FAMILY STERCORARIIDÆ.—Jaegers.

4. STERCORARIUS PARISITICUS, (Linn.)—Parasitic jaeger. Accidental. As far as I can learn, this is the first record of the occurrence of this bird in the State, or of its appearance so far inland. The single specimen, on which this record is based, was found, while still living, but completely exhausted, in a field near Lebanon, at the close of a week of very stormy weather, in the latter part of March or the early part of April, 1880. Its captor placed it in a cage and offered it corn and

bread, which diet soon completed the work of the storm. The bird was then brought to Mr. Gould and is now in his collection. The description given by Dr. Coues, of this bird, in the state just preceding adult plumage, well describes this Warren County specimen.

Family Laridæ.—Gulls and Terns.

5. Larus argentatus smithsonianus Coues.—American herring gull. A specimen, in immature plumage, now in Mr. Gould's collection, was taken at the Lebanon Reservoir in the Spring of 1880, and large gulls, almost certainly of this species, were then not uncommon in Spring and Fall. Of late none have been observed, though probably of not infrequent occurrence on the Miamis.

6. Larus philadelphia (Ord.)—Bonaparte's gull. Formerly occurred regularly, Spring and Fall, on the reservoir, usually after severe storms. Is still a Spring and Fall migrant, though rather irregular, on the Miamis.

7. Sterna hirundo Linn.—Common tern. Several specimens, now in Mr. Gould's collection, were taken at the Lebanon Reservoir. None observed of late years.

8. Hydrochelidon nigra surinamensis (Gmel.)—Black tern. Irregular Spring and Fall migrant on the Miamis. Formerly of quite regular occurrence on the Lebanon Reservoir in the Fall, and not uncommon in the Spring.

Order Steganopodes.—Totipalmate Swimmers.

Family Phalacrocoracidæ.—Cormorants.

9. Phalacrocorax dilophus floridanus (Aud.)—Florida cormorant. One specimen, a bird in immature plumage, now in Mr. Gould's collection, was taken at the Lebanon Reservoir in the Spring of 1880. Now a rare and irregular migrant on the Miamis.

Order Anseres.—Lamellirostral Swimmers.

Family Anatidæ.—Ducks, Geese and Swans.

10. Lophodytes cucullatus (Linn.)—Hooded merganser. Spring and Fall migrant, not uncommon.

11. Anas boschas Linn.—Mallard. Regular Spring and Fall migrant, not seen or taken nearly as often since the breaking of the reservoir, although this may be said of any of the species of the order.

12. Anas americana Gmel.—Widgeon. Spring and Fall migrant. One of the first ducks to arrive in the Spring.

13. Anas carolinensis Gmel.—Green-winged teal. Common Spring and Fall migrant on the Miamis.

14. Anas discors Linn.—Blue-winged teal. Spring and Fall migrant. In the days of the old reservoir more common than the last species. Now, apparently, the conditions are reversed.

15. Spatula clypeata, (Linn.)—Shoveller; spoonbill. Spring and Fall migrant, tolerably common.

16. Dafila acuta (Linn.)—Pintail. Spring and Fall migrant.

17. Aix sponsa (Linn.)—Wood duck. Spring and Fall migrant, and occasional Summer resident. Has been known to breed on the Little Miami, and a pair which spent the Summer of 1879 at the Lebanon Reservoir probably raised a brood.

18. Aythya americana (Eyt.)—Red-head. A rare migrant. Specimens have been taken at the Lebanon Reservoir.

19. Aythya affinis (Eyt.)—Lesser scaup duck. Common Spring and Fall migrant on the Miamis and their tributaries. One of the first ducks to arrive in the Spring and the last to leave in the Fall.

20. Aythya collaris (Donov.)—Ring-necked duck. Migrant with the last, but quite rare.

21. Charitonetta albeola (Linn.)—Butterball. One of the most common Spring and Fall migrants on the Miamis and their tributaries.

22. Erismatura rubida (Wils.)—Ruddy duck. Formerly of uncommon occurrence on the reservoir and now a rare migrant.

23. Branta canadensis (Linn.)—Canada goose. A regular Spring and Fall migrant. At any rate, large flocks are seen passing overhead each Spring and Fall, although few of them ever alight. Specimens have been taken, however, on the Miamis and on Turtle Creek.

ORDER HERODIONES.—Herons, Storks, Ibises, Etc.

FAMILY ARDEIDÆ.—Herons, Bitterns, Etc.

24. BOTAURUS LENTIGNOSUS (Montag.)—American bittern. A not uncommon Spring and Fall migrant.

25. ARDEA HERODIAS Linn.—Great blue heron. Common Spring and Fall migrant and a Summer resident. Breeds. What remains of the old Shaker swamps furnishes these birds a breeding place, and quite a number nest there each year.

26. ARDEA EGRETTA Gmel.—Great white egret. Formerly a tolerably regular visitant, during the later Summer and early Fall, at the Lebanon Reservoir, quite a number of specimens having been taken there; nine in one day, upon one occasion. Now comparatively rare.

27. ARDEA VIRESCENS Linn.—Green heron. Common Summer resident, from the middle of April to October. Breeds.

28. NYCTICORAX NYCTICORAX NÆVIUS (Bodd.)—Night heron. Rare Spring and Fall migrant. The single specimen in my collection was shot from the top of a tall elm, in the middle of a field, a long distance from any water or swampy ground.

ORDER PALUDICOLÆ.—Cranes, Rails, Coots, Etc.

FAMILY RALLIDÆ.—Rails.

29. RALLUS ELEGANS Aud.—King rail. Rare, but regular, Spring and Fall migrant, in April and October; more common in the Spring. Several of these birds have been captured in barns and other out-buildings, in the vicinity of Lebanon, in recent years, which, if not simply coincident accidents, would indicate a peculiar tendency of this species.

30. RALLUS VIRGINIANUS Linn.—Virginia rail. Rare Spring and Fall migrant, arriving and departing with the last named species.

31. PORZANA CAROLINA (Linn.)—Sora; Carolina rail. Rather common Spring and Fall migrant, in April, May and September.

32. FULICA AMERICANA Gmel.—Coot. Formerly a rather common Spring and Fall migrant at the Lebanon Reservoir and Shaker pond. Now, in comparison, rare.

ORDER LIMICOLÆ.—Shore Birds.

FAMILY RECURVIROSTRIDÆ.—Avocets, Stilts, Etc.

33. RECURVIROSTRA AMERICANA Gm.—Avocet. Accidental. One specimen, in Winter plumage, taken at the Lebanon Reservoir, in the Spring of 1880, and now in Mr. Gould's collection. With the exception of Dr. Kirtland's rather indefinite note ("This unique bird has been killed by sportsmen in the vicinity of Cincinnati"), this is, as far as I can learn, the second authentic record of its occurrence in the State, Mr. Dury having identified it at Cincinnati some years ago.

FAMILY SCOLOPACIDÆ.—Snipes, Sandpipers, Etc.

34. PHILOHELA MINOR (Gmel.)—Woodcock. Not uncommon Spring and Fall migrant and rare Summer resident, from March to November. Breeds.

35. GALLINAGO DELICATA (Ord.)—Jack snipe. Migrant in April, May, October and November. In some years very abundant, in others so rare, or apparently so, as to be scarcely observed. More common, as a rule, in the Spring than in the Fall, but sometimes these conditions seem to be reversed.

36. TRINGA MACULATA Viell.—Pectoral sandpiper. Migrant in March, April and October; more common in the Spring.

37. TRINGA MINUTILLA Viell.—Least sandpiper. Formerly a regular migrant, quite common at the Lebanon Reservoir and Shaker pond, in August and the early Fall. Now rare, but still more common in the Fall than in the Spring.

38. TRINGA ALPINA PACIFICA (Coues.)—Dunlin. Very rare migrant. One specimen only, taken at the Lebanon Reservoir in the Fall of 1879, and now in Mr. Gould's collection.

39. EREUNETES PUSILLUS (Linn.)—Semipalmated sandpiper. Rare Spring and Fall migrant.

40. TOTANUS MELANOLEUCUS (Gmel.)—Great yellowlegs. Rare Spring and Fall migrant. Formerly rather common on the reservoir in August and September.

41. TOTANUS FLAVIPES (Gmel.)—Yellowlegs. Formerly abundant in August and September, the time of low water at the old reservoir. Now a not very common migrant in May and September.

42. TOTANUS SOLITARIUS (Wils.) — Solitary sandpiper. Common Spring and Fall migrant in April, May, August and September.

43. SYMPHEMIA SEMIPALMATA (Gmel.)—Willet. Two specimens, shot out of a flock of about fifteen, at the Lebanon Reservoir, in the Spring of 1880, are now in Mr. Gould's collection. Willets, in such flocks, were not uncommon visitants at the old reservoir in the Spring and Fall, but are now rare.

44. ACTITIS MACULARIA (Linn.)—Spotted Sandpiper. A common Summer resident, from April to September. Breeds.

FAMILY CHARADRIIDÆ.—Plovers.

45. CHARADRIUS DOMINICUS (Müll.)—Golden plover. Rare Spring and Fall migrant.

46. ÆGIALITIS VOCIFERA (Linn.)—Killdeer. A common Summer resident, from March to November. Breeds.

ORDER GALLINÆ.—Gallinaceous Birds.

FAMILY TETRAONIDÆ.—Grouse, Etc.

47. COLINUS VIRGINIANUS (Linn.)—Quail. An abundant resident. Breeds.

48. BONASA UMBELLUS (Linn.)—Ruffed grouse. Formerly, in the early days of the county, before the timber was cleared away, "partridges" were common, many of the older residents of the county remembering them, and, more particularly, their drumming in the Spring. They bred, of course. Just when they disappeared from the county is not definitely known, but it was not far from 1860.

FAMILY PHASIANIDÆ.—Turkeys.

49. MELEAGRIS GALLOPAVO Linn.—Wild Turkey. Formerly a common resident, breeding; now extinct in the county. It was never abundant after about 1845, but occurred in the county as late as early in the sixties.

ORDER COLUMBÆ.—Pigeons and Doves.

FAMILY COLUMBIDÆ.—Pigeons and Doves.

50. ECTOPISTES MIGRATORIUS (Linn.)—Wild Pigeon. Formerly abundant, the great flights of wild pigeons being well

remembered. Now an irregular Spring and Fall migrant; more common in the Fall.

51. Zenaidura macroura, (Linn.)—Mourning dove; turtle dove. A common resident, abundant in Spring, Summer and Fall, and rare in Winter, when it is represented only by small flocks in the corn-fields. The great bulk of them arrive in March and go South in October and November. In the Fall they gather in flocks, which sometimes number as high as a hundred individuals. Breeds. Three and, exceptionally, four and five broods are raised in a season, the birds not unfrequently nesting on the ground, though the nest is usually found in thick, bushy trees, not far from the ground, or in evergreens.

Order Raptores.—Birds of Prey.

Family Cathartidæ.—North American Vultures.

52. Cathartes aura (Linn.)—Turkey vulture. Resident from March to December, during which time it is common. In mild seasons, a few winter along the river hills. Breeds.

53. Catharista atrata (Bartr.)—Black vulture. A rather uncommon, but regular, Summer resident, from March to October, in the north-east part of the county, along the Little Miami and Cæsar's Creek hills, where it breeds, and is each year becoming more common. On the farm of Commissioner W. J. Collett is a large sycamore tree, in the hollow of which a pair of turkey vultures had nested for a number of years. A few years ago, Mr. Collett informs me, when the turkey vultures had completed their nest, they were driven from it by a pair of black vultures, which took possession, and have used it as a nesting-place each year since. This is, I think, the northernmost record of this vulture breeding, and the first record of its breeding in the State. The first positive record of its appearance in the county I have is my own observation of a pair near Lebanon, in December, 1883. The Cæsar's Creek country residents vary greatly as to the time of the first appearance of the "new kind of buzzard," but it was about eight or ten years ago, since which time they have steadily increased in numbers, and, although even now they are by no means common, yet they are regular Summer residents and breed here each year.

FAMILY FALCONIDÆ. Falcons, Hawks, Etc.

54. ELANOIDES FORFICATUS (Linn.) Swallow-tailed kite. Formerly an abundant resident in all parts of the State; now seldom, if ever, occurring and it has been practically extinct in the State for twenty years. The older residents of the county well recollect a "swallow-tailed hawk" that was formerly of quite common occurrence in the county, which was, unquestionably, this species.

55. CIRCUS HUDSONIUS (Linn.)—Marsh hawk. Rare Spring and Fall migrant, more common in the Fall than in the Spring.

56. ACCIPITER COOPERI (Bonap.)—Cooper's hawk. Common resident from March to November, a few stragglers occasionally remaining through the Winter. Breeds.

57. BUTEO BOREALIS (Gmel.)—Red-tailed hawk. A not uncommon resident, much more abundant some years than others. Breeds

58. BUTEO LINEATUS (Gmel.)—Red-shouldered hawk. Common resident. Breeds. Our most common large hawk.

59. BUTEO LATISSIMUS (Wils.)—Broad-winged hawk. Rather uncommon resident, from April to November. Breeds.

60. AQUILA CHRYSAETOS (Linn.)—Golden eagle. Rare migrant, or more properly, an occasional visitant. One or two specimens of this species and several of the next have been taken along the Little Miami hills in recent years.

61. HALIÆETUS LEUCOCEPHALUS (Linn.)—Bald eagle. Irregular visitant, usually in the Fall or Winter.

62. FALCO COLUMBARIUS Linn.—Pigeon hawk. A rare Spring and Fall migrant.

63. FALCO SPARVERIUS Linn.—Sparrow hawk. Common resident; the most abundant representative of the order. Breeds. Less common in Winter, but a considerable number remain.

64. PANDION HALIAETUS CAROLINENSIS (Gmel.)—Fish hawk. Uncommon Spring and Fall migrant, and is also of irregular occurrence during the Summer.

FAMILY STRIGIDÆ.—Owls.

65. ASIO WILSONIANUS (Less.)—Long-eared owl. Very rare Winter resident. I have personal knowledge of but two specimens, one of which was brought to me to mount in the Winter of 1884-5, by some one whose name I have lost; the other I found dead in the fork of a small tree, in which it had apparently been caught while in pursuit of some small bird or mammal. This was in December, 1886. Mr. Dury also records a long-eared owl from this county in 1886.

66. ASIO ACCIPITRINUS (Pall.)—Short-eared owl. Ordinarily a rare Winter resident. But during the Fall and Winter of 1886, short-eared owls were abundant throughout the county. They were associated in flocks of from five to thirty individuals. When disturbed from their roosting places, which were usually along drains and water-washed hollows in meadow fields, they would fly rapidly for a short distance and then, sweeping in wide circles, would rise to a height of three or four hundred feet, where they would remain, soaring in large circles, until danger was past. Few have been seen since.

67. SYRNIUM NEBULOSUM (Forst.)—Barred owl. An uncommon resident, possibly more common in Winter. Breeds.

68. MEGASCOPS ASIO (Linn.)—Screech owl. A common resident. Breeds.

69. BUBO VIRGINIANUS (Gmel.)—Great horned owl. A common resident. Breeds in February and March. In speaking of this bird, Dr. Coues says "Eggs said to be 3–6, not known to me to be more than two in number." In the limb of a hollow tree, felled by wood-choppers in March, 1883, near Lebanon, was found a horned owl's nest containing four young owls. One was killed by the fall, but the other three were kept for some time as pets by one of the choppers.

70. NYCTEA NYCTEA (Linn.)—Snowy owl. Visitant in severe Winters. Quite a number of specimens have been taken in the county, the last instance of which I have record being the taking of a pair in Harlan, the south-eastern township of the county, early in 1887.

Order Psittaci.—Parrots, Etc.

Family Psittacidæ.—Parrots.

71. Conurus carolinensis (Linn.)—Paroquet. Formerly an abundant Summer resident, breeding within the memory of persons now living. Has been extinct in the county for many years.

Order Coccyges.—Cuckoos, Kingfishers, Etc.

Family Cuculidæ.—Cuckoos.

72. Coccyzus americanus (Linn.)—Yellow-billed cuckoo; rain crow. An abundant Summer resident from May to September. Breeds.

73. Coccyzus erythrophthalmus (Wils.)— Black-billed cuckoo. Rare Summer resident, arriving and departing with the last. Probably breeds.

Family Alcedinidæ.—Kingfishers.

74. Ceryle alcyon (Linn.)—Belted kingfisher. A common resident from March to December, and during open seasons a number winter along the creeks and rivers of the county. Breeds.

Order Pici.—Woodpeckers.

Family Picidæ.—Woodpeckers.

75. Dryobates villosus (Linn.)— Hairy woodpecker. Resident; common in Winter, rare in Summer. Probably bree s.

76. Dryobates pubescens (Linn.)— Downy woodpecker. Common resident, much more common than the last. More abundant in Winter. Breeds.

77. Sphyrapicus varius (Linn.)— Yellow-bellied woodpecker. A regular, but not very common Spring and Fall migrant in April and November.

78. Ceophloeus pileatus (Linn.)— Pileated woodpecker; log cock. Formerly a common resident. Bred. Well remembered as occurring abundantly by men of middle life, but has been extinct in the county for 20 or 25 years.

79. Melanerpes erythrocephalus (Linn.)—Red-headed woodpecker. Resident from March to November in abund-

ance. Breeds. In Mr. Gould's collection there is a very curious albino of this species. In it, the red and white are distributed as in the ordinary bird, but the blue-black area is replaced by one of pale, shaded chocolate. The bird was taken near Lebanon in the Fall of 1879.

80. Melanerpes carolinus (Linn.) — Red-bellied woodpecker. Resident; rare in Summer, abundant in Fall, Winter and Spring.

81. Colaptes auratus, (Linn.)—Flicker; yellowhammer. An abundant resident. Breeds.

Order Machrochires.—Goatsuckers, Swifts, Etc.

Family Caprimulgidæ.—Goatsuckers.

82. Antrostomus vociferus (Wils.)—Whip-poor-will. A rare Summer resident, probably breeding. Is more common in May. Not observed in the Fall.

83. Chordeiles virginianus (Gmel.)—Night hawk. Uncommon Summer resident, probably breeding. Common during May, and abundant in September and October.

Family Micropodidæ.—Swifts.

84. Chætura pelagica (Linn.)—Chimney swift. Abundant Summer resident, from April to October. Breeds.

Family Trochilidæ.—Hummingbirds.

85. Trochilus colubris Linn.—Ruby-throated hummingbird. A common Summer resident, from May 1 to September 15.

Order Passeres.—Perching Birds.

Family Tyrannidæ.—Tyrant Flycatchers.

86. Tyrannus tyrannus (Linn.)—Kingbird. A common Summer resident, from May to September. Breeds.

87. Myiarchus crinitus (Linn.)—Crested Flycatcher. A common Summer resident, from the first of May to the middle of September. Breeds.

88. Sayornis phœbe (Lath.)—Peewee; phœbe. Common Summer resident, from the last of March to the first of October. Breeds. Two and frequently three broods.

89. CONTOPUS VIRENS (Linn.)—Wood peewee. Common Summer resident, from May to October. The commonest of the small flycatchers. Breeds.

90. EMPIDONAX FLAVIVENTRIS Baird.—Yellow-bellied flycatcher. Spring and Fall migrant; not uncommon.

91. EMPIDONAX ACADICUS (Gmel.)—Acadian flycatcher. Resident from May to September. Breeds.

92. EMPIDONAX MINIMUS Baird.—Least flycatcher. Spring and Fall migrant, in May and September, arriving and departing with flaviventris.

FAMILY ALAUDIDÆ.—Larks.

93. OTOCORIS ALPESTRIS (Linn.)—Horned lark. Resident from October to April, although very severe Winters drive the great bulk of them farther South. Usually abundant in November, when they gather in the meadows in large flocks, but in some seasons only a few are seen.

FAMILY CORVIDÆ.—Crows and Jays.

94. CYANOCITTA CRISTATA (Linn.)—Blue jay. A common resident. Breeds.

95. CORVUS AMERICANUS Aud.—Crow. A common resident. Breeds. In speaking of the crow as a resident, it should be stated that the crows to be seen in all parts of the county any Winter day, return every evening to the great crow roost at Clifton, a suburb of Cincinnati. Every morning, from November to March, they arrive in the vicinity of Lebanon about an hour after sun-rise. The day is spent searching for food along the numerous water-courses of the county, and about three o'clock in the afternoon they may be seen returning, in small flocks, to the Clifton roost. So, while during the daytime, in Winter, crows are more abundant than at any other time of the year, by five o'clock in the afternoon there is probably not a crow left in the county.

FAMILY ICTERIDÆ.—Orioles.

96. DOLICHONYX ORYZIVORUS, (Linn.)—Bobolink. Uncommon migrant, early in May, in small flocks. Breeds at Yellow Springs (Wheaton), twenty miles north of the Warren County line.

97. MOLOTHRUS ATER (Bodd.)—Cowbird. Abundant Summer resident, from the last of February to October. Breeds.

98. AGELAIUS PHŒNICEUS (Linn.)—Red-winged blackbird. Common Summer resident, arriving and departing with the last species. Abundant during the migrations. Breeds.

99. STURNELLA MAGNA (Linn.)—Meadow lark. An abundant resident from March 1st to December 1st, and, except in very severe seasons, a number remain throughout the year. Breeds.

100. ICTERUS SPURIUS (Linn.)—Orchard Oriole. Rather common Summer resident, from May 1st to September 1st. Breeds.

101. ICTERUS GALBULA (Linn.)—Baltimore oriole. Common Summer resident, from the last of April to the middle of September. Breeds.

102. SCOLEOPHAGUS CAROLINUS (Müll.)—Rusty blackbird. Common Spring and Fall migrant, in April, May, October and November.

103. QUISCALUS QUISCULA ÆNEUS (Ridgw.)—Bronzed grackle; blackbird. Abundant resident, from the last of February to the first of November. Very numerous, in great flocks, during the migrations. Breeds. One seen December 30, 1887.

FAMILY FRINGILLIDÆ.—Finches, Sparrows, Etc.

104. CARPODACUS PURPUREUS (Gmel.)—Purple finch. Migrant in April, May and October. Probably a rare Winter resident.

105. LOXIA CURVIROSTRA MINOR (Brehm.)—American crossbill. Rare and irregular Winter visitant. None have been observed in this county in recent years, but a flock of them appeared at Wilmington, some eight miles east of the county line, in February, 1887.

106. LOXIA LEUCOPTERA, Gmel.—White-winged crossbill. Very irregular Winter visitant; not observed for a number of years.

107. SPINUS TRISTIS (Linn.)—Goldfinch. Abundant resident; less common in Winter. Breeds.

108. Plectrophenax nivalis (Linn.)—Snow bunting. Irregular Winter visitant; not observed for several years.

109. Poocætes gramineus (Gmel.)—Grass finch. A common resident, from April to November. Breeds.

110. Ammodramus sandwichensis savanna (Wils.)—Savanna sparrow. A not uncommon Spring and Fall migrant.

111. Ammodramus savannarum passerinus. (Wils.)—Yellow-winged sparrow. A very rare Summer resident. One specimen only, identified at Franklin, in the northwestern part of the county, June 30, 1890, which was in song at the time. Probably breeds.

112. Chondestes grammacus (Say.)—Lark finch. Migrant during the last of April and the first of May, and the last of August and the first of September. Uncommon. Is a rare Summer resident and breeder.

113. Zonotrichia leucophrys (Forst.)—White-crowned sparrow. Migrant with the next species, but less common.

114. Zonotrichia albicollis (Gmel.)—White-throated sparrow. Common Spring and Fall migrant, in April, May, October and November.

115. Spizella monticola (Gmel.)—Tree sparrow. Common Winter resident, from October to April.

116. Spizella socialis (Wils.)—Chipping sparrow. Abundant Summer resident, from the last of March to the last of October. Breeds.

117. Spizella pusilla (Wils.)—Field sparrow. Common Summer resident, arriving and departing with the last species. Breeds.

118. Junco hyemalis (Linn.)—Snowbird. Abundant Winter resident, from October 15 to April 15.

119. Melospiza fasciata (Gmel.)—Song sparrow. Abundant resident. Breeds.

120. Melospiza lincolni (Aud.)—Lincoln's sparrow. Rare migrant. One specimen only, taken near Lebanon, May 2, 1890.

121. Melospiza georgiana (Lath.)—Swamp sparrow. Spring and Fall migrant, in April and October.

122. PASSERELLA ILIACA (Merr.)—Fox sparrow. A not uncommon Spring and Fall migrant.

123. PIPILO ERYTHROPHTHALMUS (Linn.)—Ground robin. Common resident, from March to November, and a few may Winter in the county in mild seasons. Breeds.

124. CARDINALIS CARDINALIS (Linn.)—Cardinal grosbeak; redbird. A common resident. Breeds.

125. HABIA LUDOVICIANA (Linn.)—Rose-breasted grosbeak. Uncommon Spring and Fall migrant, in April, May and September.

126. PASSERINA CYANEA (Linn.)—Indigo bunting. A common resident, from May to October.

127. SPIZA AMERICANA (Gmel.) — Dickcissel. Abundant Summer resident from May to September. Breeds.

128. PASSER DOMESTICUS, Linn.—English sparrow. Abundant resident. Breeds. Introduced about 1875.

FAMILY TANAGRIDÆ.—Tanagers.

129. PIRANGA ERYTHROMELAS Viell.— Scarlet tanager. Rare Summer resident, quite common during May and September. Breeds.

130. PIRANGA RUBRA (Linn.)— Summer tanager. Arrives and departs with the last species. Less common during the migrations, but more remain during the Summer. Breeds.

FAMILY HIRUNDINIDÆ.—Swallows.

131. PROGNE SUBIS (Linn.)—Martin. A common Summer resident, from April to September. Breeds.

132. PETROCHELIDON LUNIFRONS (Say.) — Eave swallow. Common Summer resident, from the middle of April to the middle of September. Breeds.

133. CHELIDON ERYTHROGASTER (Bodd.)—Barn swallow. Common Summer resident, from April to September. Breeds.

134. TACHYCINETA BICOLOR (Viell.)—White-bellied swallow. Uncommon migrant in May and September.

135. CLIVICOLA RIPARIA (Linn.)—Bank swallow. Common Summer resident, from April to September. Breeds.

136. Stelgidopteryx serripennis (Aud.)—Rough-winged swallow. Summer resident, arriving and departing with the last species. Breeds.

Family Ampelidæ.—Waxwings.

137. Ampelis cedrorum (Viell.)—Cedar bird. A very irregular bird. Usually common during the migrations, but in some seasons quite rare. Sometimes an uncommon Summer resident, probably breeding, again not observed at all during other Summers. At times appearing so late in the Fall and so early in the Spring (November 29th; January 25th), as to give the impression that in some years it may be a rare Winter resident.

Family Laniidæ.—Shrikes.

138. Lanius ludovicianus Linn.—Loggerhead shrike. Spring and Fall migrant and uncommon Summer resident. Breeds.

139. Lanius ludovicianus excubitorides (Swain.)—White-rumped shrike. Migrant and resident with the last. Probably breeds.

The shrikes of this locality are just on the border line between the loggerheads and the white-rumps, and in many cases it is almost impossible to distinguish the variety. Dr. F. W. Langdon, of Cincinnati, who is an authority on the birds of this section, considers the white-rump our common variety. I have never found it nesting in this county, as I have undoubted loggerheads, but it unquestionably breeds.

Family Vireonidæ.—Vireos.

140. Vireo olivaceus (Linn.)—Red-eyed vireo. Common Summer resident, from May to October. Breeds.

141. Vireo gilvus (Viell.)—Warbling vireo. Common Summer resident, arriving and departing with the last. Breeds.

142. Vireo flavifrons Viell.—Yellow-throated vireo. Migrant in May and September. Possibly a rare Summer resident, but not noted as such.

143. Vireo noveboracensis (Gmel.)—White-eyed vireo. Summer resident, May to September. Breeds.

FAMILY MNIOTILTIDÆ.—Warblers.

144. MNIOTILTA VARIA (Linn.)—Summer resident, from May to September. Breeds. As in the case with all warblers which are Summer residents in the county, is much more common during the migrations.

145. HELMINTHOPHILA PINUS (Linn.)—Blue-winged warbler. Rather uncommon Summer resident. Breeds.

146. HELMINTHOPHILA PEREGRINA (Wils.) — Tennessee warbler. Common Spring and Fall migrant.

147. DENDROICA ÆSTIVA (Gmel.)—Yellow warbler. Abundant Summer resident, from the middle of May to the last of August. Breeds.

148. DENDROICA CÆRULESCENS (Gmel.)—Black-throated blue warbler. Uncommon migrant, in May and September.

149. DENDROICA CORONATA (Linn.)—Yellow-rumped warbler. A common migrant, in April, May and October.

150. DENDROICA MACULOSA (Gmel.)—Black and yellow warbler. Migrant in May and September; much more common in the Fall.

151. DENDROICA CÆRULEA (Wils.)—Cerulean warbler. Rather common migrant and rare Summer resident, from May to August. Breeds.

152. DENDROICA PENSYLVANICA (Linn.) — Chestnut-sided warbler. Spring and Fall migrant; common in September.

153. DENDROICA CASTANEA (Wils.)—Bay-breasted warbler. Spring and Fall migrant; common in September.

154. DENDROICA STRIATA (Forst.) — Black-poll warbler. Rare migrant, in May and September.

155. DENDROICA BLACKBURNIÆ (Gmel.)—Blackburnian warbler. Migrant in May and September; much more common during the latter month.

156. DENDROICA DOMINICA ALBILORA, Baird. Sycamore warbler. Common migrant in April, and is one of the first, if not the first, of the warblers to arrive. Not observed in the Fall.

157. DENDROICA VIRENS (Gmel.)—Black-throated green warbler. Common Spring and Fall migrant.

158. DENDROICA PALMARUM (Gmel.)—Yellow red-poll warbler. Migrant in April and October; more common in the Fall.

159. SEIURUS AUROCAPILLUS (Linn.) — Golden-crowned water thrush. Summer resident, from April to September. Breeds.

160. SEIURUS MOTACILLA (Viell.)—Large-billed water thrush. Common Summer resident, in the thickly wooded hills along the Little Miami; comparatively rare elsewhere in the county. Arrives early in April and leaves the last of August. Breeds.

161. GEOTHLYPIS FORMOSA (Wils.)—Kentucky warbler. Uncommon Summer resident. Probably breeds.

162. GEOTHLYPIS AGILIS (Wils.)—Connecticut warbler. Very rare migrant One specimen only, taken near Lebanon, in May, 1879, and now in Mr. Gould's collection.

163. GEOTHLYPIS PHILADELPHIA (Wils.)—Mourning warbler. Rare migrant. One specimen only, taken at Ft. Ancient, May 26, 1890.

164. GEOTHLYPIS TRICHAS (Linn.)—Maryland yellow-throat. Summer resident, from May to September; common during the migrations. Breeds.

165. ICTERIA VIRENS (Linn.)—Yellow-breasted chat. Common Summer resident, from the middle of May to the first of September. Breeds.

166. SETOPHAGA RUTICILLA (Linn.)—Redstart. Summer resident, from May to September; much more common during the migrations. Breeds.

FAMILY MOTACILLIDÆ.—Wagtails.

167. ANTHUS PENSILVANICUS (Lath.)—Titlark. Spring and Fall migrant, in March, April and November, in flocks.

FAMILY TROGLODYTIDÆ.—Wrens.

168. MIMUS POLYGLOTTOS (Linn.)—Mockingbird. A rare Summer resident. Breeds. Mr. Gould's collection contains an albino mocking bird. It is not pure white, and all the markings of the ordinary bird can be made out, but the col-

oring is so light that, at a little distance, it seems to be almost white. It was shot in a swamp in Mississippi, early in 1882.

169. GALEOSCOPTES CAROLINENSIS (Linn.)—Catbird. Abundant Summer resident, from the middle of April to the first of October. Breeds.

170. HARPORHYNCHUS RUFUS (Linn.)—Brown thrush. Common Summer resident, from April to September. Breeds.

171. THRYOTHORUS LUDOVICIANUS (Lath.)—Carolina wren. Common resident. Breeds.

172. THRYOTHORUS BEWICKII (Aud.)—Bewick's wren. A rare Summer resident, probably a comparatively recent addition to the fauna of the county. Its rarity prevents the giving of dates of arrival and departure, with anything like certainty, but I have seen it as early as April 15th and as late as August 10th. Probably breeds.

173. TROGLODYTES AEDON (Viell.)—House wren. Formerly a rather common resident. Of late years, quite rare. Breeds.

174. TROGLODYTES HIEMALIS Viell.—Winter wren. Uncommon Winter visitant, November to April.

175. CISTOTHORUS PALUSTRIS (Wils.)—Long-billed marsh wren. Rare Spring and Fall migrant.

FAMILY CERTHIIDÆ.—Creepers.

176. CERTHIA FAMILIARIS AMERICANA (Bonap.)—Brown creeper. Common migrant in March, April, October and November, and rare Winter resident.

FAMILY PARIDÆ.—Nuthatches and Titmice.

177. SITTA CAROLINENSIS Lath.—White-bellied nuthatch. Resident; more common in Winter. Breeds.

178. SITTA CANADENSIS Linn.—Red-bellied nuthatch. Irregular Winter visitant, sometimes in considerable numbers. Not observed since December, 1888.

179. PARUS BICOLOR Linn.—Tufted titmouse. Resident; more common in Winter. Breeds.

180. PARUS CAROLINENSIS Aud.—Carolina chickadee. A common resident, more numerous in Winter. Breeds.

FAMILY SYLVIIDÆ.—Kinglets, Etc.

181. REGULUS SATRAPA Licht.—Golden-crowned kinglet. Common Spring and Fall migrant, usually in small flocks. A rare Winter resident.

182. REGULUS CALENDULA (Linn.)—Ruby-crowned kinglet. Uncommon, but regular migrant, in April and October.

183. POLIOPTILA CÆRULEA (Linn.)—Blue-gray gnatcatcher. Summer resident, April to August; more common in the Spring. Breeds.

FAMILY TURDIDÆ.—Thrushes.

184. TURDUS MUSTELINUS Gmel.—Wood thrush. Common Summer resident, from April to October. Breeds.

185. TURDUS ALICIÆ Baird.—Gray-cheeked thrush. Migrant in May, September and October.

186. TURDUS USTULATUS SWAINSONII (Cab.)—Olive-backed thrush. A very common migrant in April, May and September.

187. TURDUS AONALASCHÆ PALLASII (Cab.)—Hermit thrush Common migrant, in April, May, September and October.

188. MERULA MIGRATORIA (Linn.)—Robin. Abundant resident, from February to November, and a small number sometimes Winter in the county. Very numerous, in large straggling flocks, during the migrations. Breeds.

189. SIALIA SIALIS (Linn.)—Bluebird. Common resident, from February to November, and a few usually remain through the Winter. Breeds.

LIST OF BIRDS OF PROBABLE OCCURRENCE.

In the following list are the names of a number of birds, which, to a practical certainty, occur in the county, so much so that quite a number of them might have been included in the list proper with perfect safety, and were only barred out by the rigidly adhered to rule of including no bird whose indentification within the county lines was not positive and certain. It is true that the majority of these will be found to be rare, but as they are unquestionably of tolerably reg-

ular occurrence in the county, the irregularity of my own observations must account for the fact that I have overlooked them and have no other records to which to refer. Birds of this class may be distinguished in the following list by the quotations attached to their names, the Cincinnati quotations being from Dr. F. W. Langdon's list of Cincinnati birds, and those from the State at large from Dr. Wheaton's work on the birds of the State, published in the report of the Ohio Geological Survey. Any other authorities are named. The birds to which no quotations are attached are birds which have occurred in the State, many of them being recorded from the vicinity of Cincinnati. They are birds which are liable to occur in the county any year (except a few species here included on the probability of their occurrence in former years, of which some record may yet be found), but such occurrences will in all probability be found to be very irregular, and many of them would come under the head of accidental.

Family Podicipidæ.

1. Colymbus holbœllii (Reinh.)—Holbœll's grebe.

Family Urinatoridæ.

2. Urinator lumme (Gunn.)—Red-throated loon.

Family Laridæ.

3. Larus marinus Linn.—Great black-backed gull.
4. Larus delawarensis Ord.—Ring-billed gull.
5. Larus atricilla Linn.—Laughing gull.
6. Geochelidon nilotica (Hasselq.)—Gull-billed tern.
7. Sterna forsteri Nutt.—Forster's tern.
8. Sterna dougalli Montag.—Roseate tern.
9. Sterna antillarum (Less.)—Least tern.

Family Pelecanidæ.

10. Pelecanus erythrorhynchus Gmel.—White-pelican.

Family Anatidæ.

11. Merganser americanus (Cass.)—Merganser.

12. MERGANSER SERRATOR (Linn.)—Red-breasted merganser.

13. ANAS OBSCURA Gmel.—Dusky duck. "Spring and Fall migrant" at Cincinnati. Probably a rare migrant on the Miamis.

14. ANAS STREPERA Linn.—Gadwall.

15. AYTHYA VALLISNERIA (Wils.)—Canvasback. "Rare migrant" at Cincinnati. In the State "common on Lake Erie, less common at the St. Mary's Reservoir, and rather rare generally throughout the State."

16. AYTHYA MARILA NEARCTICA Stejn.—Scaup duck.

17. GLAUCIONETTA CLANGULA AMERICANA (Bonap.)—Golden-eye. "An uncommon migrant" at Cincinnati. In the State "not very common" Spring and Fall migrant and Winter resident.

18. OIDEMIA FUSCA (Linn.)—Velvet scoter.

19. CHEN HYPERBOREA (Pall.)—Lesser snow goose.

20. ANSER ALBIFRONS GAMBELI, (Hartl.)—White-fronted goose.

21. BRANTA BERNICLA (Linn.)—Brant goose.

22. OLOR COLUMBIANUS (Ord.)—Whistling swan.

23. OLOR BUCCINATOR (Rich.)—Trumpeter swan.

FAMILY IBIDIDÆ.

24. PLEGADIS AUTUMNALIS (Hasselq.)—Glossy ibis.

FAMILY CINCONIDÆ.

25. TANTALUS LOCULATOR Linn.—Wood ibis.

FAMILY ARDEIDÆ.

26. BOTAURUS EXILIS (Gmel.)—Least bittern. "Rare Spring and Fall migrant" at Cincinnati. Not common resident in the Northern part of the State. Doubtfully identified in this county.

27. ARDEA CANDISSIMA Gmel.—Snowy heron.

FAMILY GRUIDÆ.

28. GRUS AMERICANA (Linn.)—Whooping crane.

29. GRUS MEXICANA (Müll.)—Sandhill crane.

Family Rallidæ.

30. Porzana noveboracensis (Gmel.)—Yellow-rail. "Rare Spring and Fall migrant" at Cincinnati. "Not common Spring and Fall migrant, probably Summer resident" in the State.

31. Porzana jamaicensis (Gmel.)—Black rail.

32. Ionornis martinica (Linn.)—Purple gallinule.

33. Gallinula galatea (Licht.)—Florida gallinule.

Family Phalaropodidæ.

34. Crymophilus fulicarius (Linn.)—Red phalarope.

35. Phalaropus lobatus (Linn.)—Northern phalarope

36. Phalaropus tricolor (Viell.)—Wilson's phalarope.

Family Recurvirostridæ.

37. Himantoptus mexicanus (Müll.)—Black-necked stilt.

Family Scolopacidæ.

38. Macrorhampus griseus (Gmel.)—Red-breasted snipe. "Rare Spring and Fall migrant" at Cincinnati. "Not common migrant" in the State.

39. Micropalma himantopus (Bonap.)—Stilt sandpiper.

40. Tringa canutus Linn.—Knot.

41. Tringa bairdii (Coues.)—Baird's sandpiper.

42. Calidris arenaria (Linn.)—Sanderling.

43. Limosa fedoa (Linn.)—Marbled godwit.

44. Limosa hæmastica (Linn.)—Hudsonian godwit.

45. Bartramia longicauda (Bechst.)—Upland plover.

46. Tryngytes subruficollis (Viell.)—Buff-breasted sandpiper.

47. Numenius longirostris Wils.—Long-billed curlew.

48. Numenius hudsonicus Lath.—Hudsonian curlew.

49 Numenius borealis (Forst.)—Eskimo curlew.

Family Charadriidæ.

50. Charadrius squatarola (Linn.)—Black-bellied plover. "Rare Spring and Fall migrant" at Cincinnati. "Rather rare

Spring and Fall migrant, more frequently seen on the lake shore than elsewhere" in the State.

51. ÆGIALITIS SEMIPALMATA Bonap. — Semipalmated plover. "Uncommon Spring and Fall migrant" at Cincinnati. "Not common in Spring, more abundant in Fall" in the State.

52. ÆGIALITIS MELODA (Ord.)—Piping plover.

FAMILY APHRIZIDÆ.

53. ARENARIA INTERPRES (Linn.)—Turnstone.

FAMILY TETRAONIDÆ.

54. TYMPANUCHUS AMERICANUS (Reich.)—Prairie chicken.

FAMILY FALCONIDÆ.

55. ACCIPITER VELOX (Wils.)—Sharp-shinned hawk. "Rare Summer resident" at Cincinnati. "Breeds" at Cincinnati—Dury. In the State, "common resident in northern, less common in middle and southern Ohio."

56. ACCIPITER ATRICAPILLUS (Wils.)—Goshawk.

57. ARCHIBUTEO LAGOPUS SANCTI-JOHANNIS (Gmel.) — Rough-legged hawk.

58. FALCO PEREGRINUS ANATUM (Bonap.)—Duck hawk.

FAMILY STRIGIDÆ.

59. STRIX PRATINCOLA Bonap.—Barn owl.

60. ULULA CINEREA (Gmel.)—Great gray owl.

61. NYCTALE ACADICA (Gmel.)—Saw-whet owl. "Rare visitant in Winter" at Cincinnati. In the State "not common resident in the northern, resident or Winter visitor in middle and southern Ohio."

62. SURNIA ULULA CAPAROCH (Müll.)—American hawk-owl.

FAMILY PICIDÆ.

63. CAMPEPHILUS PRINCIPALIS (Linn.)—Ivory-billed woodpecker.

FAMILY TYRANNIDÆ.

64. CONTOPUS BOREALIS (Swains.)—Olive-sided flycatcher.

65. EMPIDONAX PUSILLUS TRAILLII (Aud.) — Traill's fly-catcher. "Rare migrant in May and September," at Cincinnati. "Common Summer resident in central Ohio, from May to September. Breeds."

FAMILY ALAUDIDÆ.

66. OTOCORIS ALPESTRIS PRATICOLA Hensh. — Prairie horned lark. "Habitat, upper Mississippi Valley and the region of the great lakes."—A. O. U. Checklist. Almost certainly identified. Probably a rare Summer resident. On July 2, 1890, I saw, about two miles south of Lebanon, what was unquestionably a horned lark. What was probably the same bird, was seen at the same place the following day, making the identification certain as to species, but not as to variety, which, however, was almost certainly that named above. The bird was in song, and probably was breeding.

FAMILY CORVIDÆ.

67. CORVUS CORAX SINUATUS (Wagl.)—Raven. Formerly a not uncommon resident in this part of the State, at which time it almost certainly occurred in this county, but I have been unable to get any certain record of its appearance here.

FAMILY FRINGILLIDÆ.

68. ACANTHIS LINARIA (Linn.)—Redpoll.

69. SPINUS PINUS (Wils.) — Pine linnet. At Cincinnati "abundant in the Winter of 1868-9."—Dury. In the State "abundant, nearly resident; possibly breeding in northern Ohio; Winter visitor in other parts of the State."

70. CALCARIUS LAPPONICUS (Linn.) - Lapland longspur. "Rare and irregular visitant" at Cincinnati. "Common and tolerably regular Winter visitor in the vicinity of Columbus."

71. GUIRACA CÆRULEA (Linn.)—Blue grosbeak.

FAMILY LANIIDÆ.

72. LANIUS BOREALIS Viell.— Butcher bird. "Rare Fall and Winter visitant" at Cincinnati. In the State, "irregular and not very common Winter visitor."

FAMILY VIREONIDÆ.

73. VIREO PHILADELPHICUS (Cass.) — Philadelphia vireo. "Rare migrant in May and September," at Cincinnati. "Not very common, but regular, Spring and Fall migrant" in the State.

74. VIREO SOLITARIUS (Wils.)—Solitary vireo. At Cincinnati "rare migrant in May,"—Byrnes, Dury, "and September,"—Shorten. In the State, "not common Spring and Fall migrant in southern and middle Ohio."

FAMILY MNIOTILTIDÆ.

75 PROTONOTARIA CITREA (Bodd.)—Prothonotary warbler.

76. HELMINTHERUS VERMIVORUS (Gmel.) — Worm-eating warbler. "Rare Summer resident May to August," at Cincinnati. In the State, "rare Summer resident."

77. HELMINTHOPHILA CHRYSOPTERA (Linn.) — Golden-winged warbler.

78. HELMINTHOPHILA RUFICAPILLA (Wils.) — Nashville warbler. "Migrant in April, May and September," at Cincinnati. "Regular Spring and Fall migrant; common" in the State.

79. HELMINTHOPHILA CELATA (Say.) — Golden-crowned warbler.

80. COMSOTHLYPIS AMERICANA (Linn.)—Parula warbler. "Not common migrant in May and September," at Cincinnati. In the State, "not common Spring and Fall migrant in southern and middle, Summer resident in northern Ohio."

81. DENDROICA TIGRINA (Gmel.)—Cape May warbler. "Rare migrant in May and September," at Cincinnati and throughout the State.

82. DENDROICA KIRTLANDI Baird. — Kirtland's warbler.

83. DENDROICA VIGORSII (Aud.)—Pine warbler. "Rare migrant in April," at Cincinnati. In the State, "not common Spring and Fall migrant."

84. DENDROICA DISCOLOR (Viell.)—Prairie warbler. "Rare migrant in May," at Cincinnati. In southern and middle Ohio "a rare Spring and Fall migrant."

85. SEIURUS NOVEBORACENSIS (Gmel.) — Water thrush. "Rare migrant in May," at Cincinnati. In the State, "common Spring and Fall migrant."

86. SYLVANIA MITRATA (Gmel.)—Hooded warbler. "Rare migrant in May," at Cincinnati. In the State, "rare Summer resident." Doubtfully identified in this county.

87. SYLVANIA PUSILLA (Wils.)—Wilson's warbler. "Spring and Fall migrant, not common" at Cincinnati. In the State, "not common migrant in the Spring; abundant in the Fall."

88. SYLVANIA CANADENSIS (Linn.)—Canadian warbler. "Migrant in May and September; rather rare" at Cincinnati. In the State, "rather common migrant in the Spring; more rare in the Fall."

FAMILY TROGLODYTIDÆ.

89. CISTOTHORUS STELLARIS (Licht.)—Short-billed marsh wren.

FAMILY PARIDÆ.

90. PARUS ATRICAPILLUS Linn.—Black-capped chickadee. "Rare Winter visitant" at Cincinnati. In the State, "abundant resident in northern and probably eastern Ohio; not common Winter visitor in central and southern Ohio."

FAMILY TURDIDÆ.

91. TURDUS FUSCESCENS Steph.—Wilson's thrush. "Rare migrant in April," at Cincinnati. In the State, "Spring and Fall migrant in southern and central Ohio; Summer resident in northern Ohio."

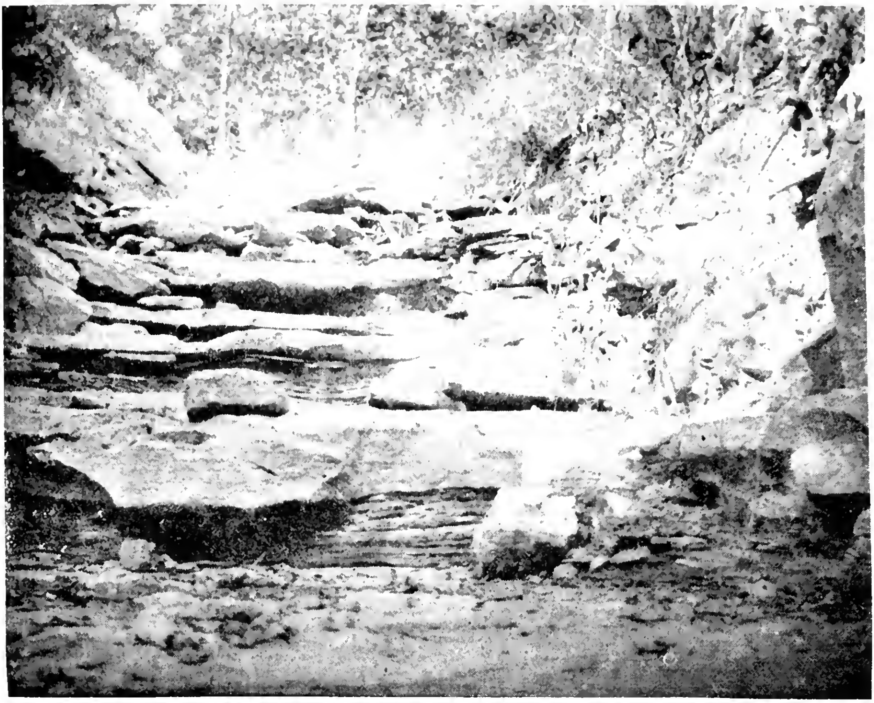


FIG. 1. CREEK AT PT. PLEASANT, O. (MIDDLE SECTION). J. F. J., AUGUST, 1890.

FIG. 2. CREEK AT PT. PLEASANT, O. (LOWER PART). J. F. J., AUGUST, 1890.

Fig. 3. Upper Part of Section at Ludlow, Ky., No. 4. Cin. Group. J. F. J., Sept., 1890.

Fig. 4. Lower Part of Section, above water's edge, Ludlow, Ky. J. F. J., Sept., 1890.

THE JOURNAL

OF THE

Cincinnati Society of Natural History.

VOL. XIV. · CINCINNATI, OCT., 1891,-JAN., 1892 · NOS. 3 & 4.

PROCEEDINGS.

REGULAR MEETING, August 4, 1891.

The Society was called to order at 8.15 P. M., President Abert in the chair.

Mr. D. W. Miller read a paper on "The Science of Harmony, or Use of Harmonics and Resultant Tones in the Formation and Progression of Chords," which was well received by the small but appreciative audience.

There being no quorum present, no further business was transacted.

REGULAR MEETING, September 1, 1891.

The Society was called to order at 8.20 P. M., President Abert in the chair.

President Abert read a paper entitled "Comparative Measurements and Proportions of the Human Form," which was listened to with much interest by those present.

As there was not a quorum of members present, no business was transacted.

For the meetings of July, October, November and December there was no quorum present, and no papers read.

DONATIONS TO JANUARY 1, 1892.

From O. J. Wilson, W. P. Anderson, Frank J. Jones, L. B. Harrison, Julius Dexter and Robert Clarke: A fine collection of East India Corals and Marine Shells, valued at $400.00.

From J. Ralston Skinner: Several specimens of Fungus (Astraeus hygrometricus), from Watch Hill, R. I.

From The Cuvier Club: The D. H. Shaffer collection of Shells, Minerals and Fossils.

From Col. Jacob Bauer: Skin of a Catfish, tanned.

From E. O. Hurd: Red Squirrel and Long-tailed Duck, both from Minnesota, mounted.

From Miss Bessie Owens: Texas Wild-cat, mounted.

BOOKS AND PAMPHLETS.

From Hon. B. Butterworth: Reports of Smithsonian Inst., 1888–89; Bulletin of U. S. Fish Com., Vol. VIII, 1888; Report of Director of U. S. Geological Survey, Vol. IV., 1888–89; Contributions to N. A. Ethnology, Vol. VI., Fourth Annual Report Bureau of Ethnology, 1882–83; Reports of S. P. Langley, 1889–90; Bulletin No. 1, U. S. Board of Geographic Names; Bibliography of the Chemical Influence of Light; Monographs U. S. Geol. Sur., Vol. X.; Tenth Annual Report U. S. Geol. Sur.; Bulletins of U. S. Geol. Sur., Vols. IV. and V.; Report of Sec. of Int., 1886–87, Vol. III, part 2; Bulletins 14, 15, 16 and 17. U. S. Coast and Geodetic Survey; U. S. Geol. and Geog. Survey of the Territories of Wyoming and Idaho, parts 1 and 2, with maps; Report of Explorations made during 1888 in the Allegheny Region of Virginia, N. Carolina and Tennessee, and in Western Indiana, with an account of the Fishes found in each of the river basins of these regions, by David Starr Jordan; Suggestions for the employment of improved types of vessels in the market fisheries, with notes on British fishing steamers, by J. W. Collins; The most recent methods of Hatching Fish Eggs; Notes on the Fishes collected at Cozumel, Yucatan, by Tarleton H. Bean; Explorations of the Fishing Grounds of Alaska, Washington and Oregon during 1888, by the U. S. Fish Com. Steamer Albatross; The Fisheries and Fishing Industries of the United

States; Bulletin 6, Experiment Station; Insect Life, Vol. I., No. 1; Journal of Mycology, Vol. VI., No. 2; Experiment Station Record, Vol. I., Nos. 2, 5 and 6, Vol. II., Nos. 1, 5, 6 and 7; Report of Microscopist for 1889; Bureau of Education, Circular of Information, No. 9, 1890.

From Prof. Jos. F. James, author: Manual of the Palæontology of the Cincinnati Group.

From State Historical Society of Wisconsin: Wisconsin Historical Collections, Vols. 2 and 3, unbound, and Vols. 4, 8, 10 and 11 bound.

From S. A. Miller: Advance sheets of the 17th Report of the Geological Survey of Indiana, Palæontology; Two copies of 16th Report of the State Geologist of Indiana.

From Robert Clarke: The Solar Parallax and its Relative Constants.

From Erwin F. Smith, author: Chemistry of Peach Yellows; The Black Peach Aphis.

From Dr. Jas. A. Henshall: Bulletins of the Department of Agriculture, France, 1890, Nos. 2 and 5, 1891, Nos. 1, 2 and 5; the 13th, 14th and 15th Annual Report of the Ohio Fish and Game Commission.

ACCESSIONS TO THE LIBRARY DURING THE YEAR 1891:

American Museum of Nat. Hist. Bulletin, Vol. III.

American Journal of Science, Vols. XLI and XLII.

American Naturalist, Vol. XXV.

American Philosophical Society, Pro., No. 135.

American Antiquarian, Vol. XIII.

American Ass. for Advancement of Science, Proceedings of 39th Meeting.

Auk, Vol. VIII.

American Monthly Microscopical Journal, Vol. XII.

American Geographical Society, Vol. XXIII., Nos. 1, 2, 3 and 4, Part 1.

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Academy of Nat. Sciences, Pro., 1891, Parts 1 and 2.

American Garden, Vol. XII.

American Geologist, Vols. VII and VIII.

Arkansas Geol. Survey, 1890, Vol. I.

Botanical Gazette, Vol. XVI.

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Bureau of Education, Circular of Information, No. 10, Rules for a Dictionary Catalogue.

Braunschwieg Verein fur Naturwissenschaft Jahresbericht, 6th.

Bremen Naturwissenschaftlichen Verein, Abhandlung, Vol. XII, Heft 1.

Buffalo Historical Society, Annual Report, 1891.

Birds of Indiana, Prof. A. W. Butler.

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Bureau of Education, Circular of Information, No. 9.

Black Peach Aphis, Erwin F. Smith.

Cassel Verein for Naturkunde Bericht, Vols. XXXVI and XXXVII.

Canadian Entomologist, Vol. XXIII.

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Columbus Horticultural Society, Vol. VII.

Comparative Medicine and Surgery, Vol. XII.

Colorado College Scientific Society, 2d Annual Pub.

Contributions to N. A. Ethnology, Vol. VI.

Chemistry of Peach Yellows, Erwin F. Smith.

Department of Agriculture: Reports of Statistician, Nos. 84, 85, 86, 87, 88, 89; Album of Agricultural Statistics for 1891; Album of Agricultural Graphics for 1891; Division of Entomology, Bulletins 7, 22, 23, 24, 25; Forestry Division, Bulletin 5; What is Forestry? Annual Reports of Secretary, 1890-91; Botanical Division, Catalogue of Economic Plants.

Department of Agriculture, France: Bulletins, 1890, Nos. 2 and 5; Bulletins, 1891, Nos. 1, 2 and 5.

Essex Institute, Bulletin, Vol. XXIII.

Entomological Society, Vol. II, No. 1.

Entomologica Americana, Vol. VII.

Elisha Mitchell Scientific Soc., Vol. VIII., Pt. 1.

Entomological News, Vol. II.

Explorations of the Fishing Grounds of Alaska, Washington and Oregon during 1888, by the U. S. Fish Com. Steamer Albatross.

Geological Soc. of London, Proceedings No. 561–577.

Geological Survey of Missouri, Bulletin No. 5.

Geological Survey of India, Records, Vol. XXIV., 1, 2, 3.

Geological Survey, Contents and Index of First 20 Vols.

Geological Survey, Palæontologia Indica Se. 10, Vol. IV.

Illinois State Laboratory of Nat. Hist., Vol. III.

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Kongl Vetenskaps Akademens Forhandlinger. Afoersigt. Arg 48, Nos. 1 to 7.

Kentucky Geological Survey. Geology of Whitley County. Geology of Clinton County. Geology of parts of Jackson and Rockcastle Counties.

Kansas City Scientist, Vol. V.

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Manchester Literary and Philosophical Society. Proceedings, Vol. IV.

Museo Nacional, Rio de Janeiro, Archives, Vol. VII.

Manitoba Historical and Scientific Society, Pamphlets No. 40 and 41.

Missouri Botanical Garden, Annual Report, 1891.

Minnesota Academy of Natural Sciences, Bulletin, Vol. III., Nos. 1 and 2.

Most Recent Methods of Hatching Fish Eggs.

Manual of the Palæontology of the Cincinnati Group, by Jos. F. James.

Monographs of U. S. Geological Survey, Vol. X.

Notes on the Fishes Collected at Cozumel, Yucatan.

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New York Microscopical Society, Journal, Vol. VII.

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New South Wales, Department of Mines. Annual Report, 1890. Palæontology, No. 5, Part 1.

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Public Museum of Milwaukee, 9th Annual Report of Trustees.

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Staten Island Nat. Science Ass. Pro. 1891.

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NORTH AMERICAN FUNGI.

By A. P. Morgan.

Fifth Paper.

(Continued from Vol. XIII., p. 21.)

(Read February 2, 1892.)

THE GASTROMYCETES.

Genus X.—Bovistella, Morg., nov. gen.

Mycelium funicular, rooting from the base. Peridium subglobose, with a well-developed base; cortex a dense floccose subpersistent coat; inner peridium thin, membranaceous, dehiscent by a regular apical mouth. Subgleba cellulose, cup-shaped above and definitely limited, persistent; capillitium originating within the tissue of the gleba; the threads free, short, several times dichotomously branched, the main stem thicker than the diameter of the spores, the branches tapering; spores small, globose or oval, even, pedicellate.

A puff ball of moderate size, growing in fields and open woods; it has the peridium of a Lycoperdon and the capillitium of a Bovista. The threads of the capillitium originate within the tissue of the gleba, along with the spores, and after deliquescence are left perfectly free within the peridium; they are altogether different from the slender subhyaline hyphæ which compose the wall of the inner peridium and have no connection with them.

1. B. Ohiensis, Ellis & Morgan. Peridium globose or broadly obovoid, sometimes much depressed, plicate underneath, with a thick cord-like root. Cortex a dense floccose coat, sometimes segregated into soft warts or spines, white or grayish in color; this dries up into a thick buff-colored or dirty ochraceous layer, which gradually falls away, leaving a smooth, shining pale-brown or yellowish surface to the inner peridium. Subgleba broad, ample, occupying nearly one-half the peridium, a long time persistent; mass of spores and capillitium lax, friable, clay-color to pale-brown; the threads

.6–.8 mm. in extent, three to five times branched, the main stem 6–8 mic. in thickness, the branches tapering; spores globose or oval, even, 4–5 mic. in length by 3.5–4 mic. in breadth, with long hyaline persistent pedicels. See Plate V., Figs. 1, 2, 3.

Growing on the ground in old pastures in fields and open woods. South Carolina, *Ravenel, Atkinson;* Florida, *Brown;* Mississippi, *Tracy;* Louisiana, *Langlois;* Ohio, *Morgan;* Indiana, *Gentry;* Illinois, *Schneck;* Missouri, *Trelease.* Peridium 1½–3 inches in diameter and about the same in height. This is *Mycenastrum Ohiense*, Ell. & Mor. Journal of Mycology, Vol. I, p. 89.

Genus XI.—Catastoma, Morg., nov. gen.

Mycelium filamentous, proceeding from all parts of the surface. Peridium subglobose, without a thickened base; cortex a fragile coat of loosely interwoven hyphae, after maturity torn asunder, leaving the lower part in the ground and a cap-shaped portion adherent above; inner peridium subcoriaceous, dehiscent by a basal aperture. Capillitium originating from the inner surface of the peridium; the threads long, branched, subhyaline, after maturity gradually breaking up into short pieces, which appear among the spores as free, short, simple or scarcely branched threads with blunt extremities; spores globose, warted, pale-brown, sessile or pedicellate.

Puffballs growing just beneath the surface of the ground and connected immediately with it by filamentous threads, which issue from every part of the cortex; after maturity, when the peridium breaks away, the lower part of the outer coat is held fast by the soil, while the upper portion, which has attained the surface, remains, covering the inner peridium like a cap or inverted cup; consequently the apparent apex at which the mouth is situated is the actual base of the plant as it grows. The capillitium threads are similar to the densely interwoven hyphæ, which form the inner peridium and are evidently branches of them radiating into the interior. It is plain that the affinities of these plants are closest with Tylostoma and Astræus, but the needs of a systematic arrangement, according to more obvious characters, causes us to place them next to Bovista.

1. C. CIRCUMSCISSUM, B. & C. Peridium subglobose, more or less depressed, and often quite irregular; cortex thickish, fragile, usually rough and uneven from the adhering soil, after maturity torn away, leaving the lower two-thirds or more in the ground; inner peridium depressed-globose, subcoriaceous, rather thin, pallid, becoming gray, minutely furfuraceous, with a small regular basal mouth. Mass of spores and capillitium soft, compact, then friable, olivaceous, changing to pale brown; the pieces of the threads short, unequal in length, flexuous, hyaline, 3–4 mic. in thickness; spores globose, minutely warted, 4–5 mic. in diameter, often with a minute pedicel. See Plate V., Figs. 4, 5, 6, 7, 8, 9.

Growing in heavy clay soil in old lanes and pastures, especially along the hard-trodden paths. Maine, *Blake;* Ohio, *Morgan;* Kansas, *Kellerman;* Nebraska, *Webber.* Inner peridium ½–¾ of an inch in diameter. This is *Bovista circumscissa*, B. & C., of Berkeley's Notices of N. A. Fungi. It grows in great abundance with us some seasons, right in the hard-trodden barnyard, and along the lane to the cattle pasture. *Arachnion album*, Schw., usually keeps it company.

2. C. SUBTERRANEUM, Peck. Peridium subglobose, often irregular; cortex thickly incrusted and browned by the adherent soil, fragile, after maturity torn asunder, leaving much the greater portion in the ground; inner peridium subglobose, somewhat irregular, subcoriaceous, thickish, smooth, whitish, becoming brown, dehiscent within the base by an irregular lacerate aperture. Mass of spores and capillitium soft, compact, then friable, olivaceous, changing to brown; the pieces of the threads short, unequal in length, flexuous, hyaline, 3–4 mic. in thickness; spores globose, distinctly warted, 6–8 mic. in diameter, sessile.

Growing in thick grass in sandy soil. Wisconsin, *Trelease;* Dakota, *Irish;* Colorado, *Webber.* Inner peridium ½–1 inch in diameter. This is *Bovista subterranea*, Peck, Botanical Gazette, Vol. IV., p. 216. It is readily distinguished from the preceding species by its much larger spores, more distinctly warted.

3. C. PEDICELLATUM, Morg. n. sp. Peridium subglobose, more or less irregular; cortex rather thin, incrusted with soil, fragile, after maturity torn away, leaving the greater part or sometimes the whole in the ground; inner peridium

depressed-globose, subcoriaceous, thinnish, pallid or gray becoming brown, smooth and shining, dehiscent at the base by a small regular mouth. Mass of spores and capillitium soft, compact, then friable, olivaceous, changing to brown; the pieces of the threads short, unequal in length, flexuous, hyaline, 3–4 mic. in thickness; spores globose, distinctly warted, 8–9 mic. in diameter, with a long, persistent hyaline pedicel.

Growing in sandy soil. South Carolina, *Ravenel*. Inner peridium ¾–1¼ inches in diameter. This was sent to me for *Bovista nigrescens*, but neither threads nor spores would permit such a reference. There are quite likely more species of these curious things in the southern and western sections of the country. George Massee's article on Bovista, in the Journal of Botany, Vol. XXVI., p. 129, shows there is a considerable number of species elsewhere.

Genus XII.—Bovista, Dill.

Mycelium fibrous or sometimes filamentous. Peridium subglobose, without a thickened base; cortex a thin fragile continuous layer, shelling off or disappearing at maturity, except sometimes a small portion about the base; inner peridium thin, membranaceous, becoming papyraceous, dehiscent by an apical mouth or opening irregularly. Capillitium originating within the tissue of the gleba; the threads free, short, several times dichotomously branched, the main stem much thicker than the diameter of the spores, the branches tapering; spores small, globose or oval, even, brown.

Puffballs of small size, growing in fields and woods; they mostly grow above ground, but one is hypogœous. They are specially characterized by the peculiar threads of the capillitium; these originate within the tissue of the gleba along with the spores, and after deliquescence are left wholly free within the peridium. Each thread has a short, thick primary stem, three or four times thicker than the diameter of the spores, which sends out branches in both directions, these again branch several times with constantly diminishing thickness, the ultimate branches tapering to a fine point. The fine slender hyphae, which compose the wall of the inner peridium, and branches of which form a fleecy lining upon its inner surface, do not resemble the capillitium-threads, nor are they connected with them.

a. Peridium with an irregular lacerate mouth, the spores sessile.

1. B. PILA, B. & C. Peridium globose or obovoid, with a stout cord-like root. Cortex a thin, white, smooth continuous coat, breaking up at maturity into minute scales, which soon disappear; inner peridium thickish, tough, rigid, becoming brown or purplish-brown, smooth and shining, a long time persistent, and finally, with age, often fading to silvery-gray; dehiscence taking place at length by an irregular torn aperture at or about the apex. Mass of spores and capillitium very firm, compact and persistent, at first clay-colored pale-brown or olivaceous, at length dark or purplish-brown; the threads rather small, .6–.8 mm. in extent, three to five times branched, the main stem 12–15 mic. thick, the ultimate branches rigid, nearly straight, tapering to a fine point; spores globose, even, 4–5 mic. in diameter, sessile or with only a minute pedicel.

Growing on the ground in woods. New England, *Humphrey;* New York, *Peck;* Pennsylvania, *Gentry;* Ohio, *Morgan. Wright;* Wisconsin, *Lapham, Trelease;* Iowa, *McBride.* Peridium 1½–2½ inches in diameter. This Bovista is remarkably tough, it maintains its shape firmly and persists a long time; it breaks away from its root and rolls about over the old leaves before the wind even till the following season. There is nothing in the description of *B. stuppea*, Berk., to separate it from this species; *B. tabacina*, Sacc, is said to be this same thing. *Mycenastrum Oregonense*, E. & E., was founded on specimens of this puffball.

2. B. MONTANA, Morg. n. sp. Peridium subglobose with a cord-like root. Cortex a thin white continuous layer, breaking up at maturity into a mealy or furfuraceous coat, which soon falls away; inner peridium thin, flaccid, becoming brown, smooth and shining, dehiscent by an irregular torn aperture about the apex. Mass of spores and capillitium soft, lax, at first ochraceous or pale-brown, finally purplish-brown; the threads curled and flexuous, very large, with an expanse of 1.25–1.75 mm., four to seven times branched, the main stem 15–20 mic. in thickness, the ultimate branches long and tapering; spores globose, even, 4.5–5.5 mic. in diameter, often with a minute pedicel.

Growing on the ground. Rocky Mountains, *Jones.* Peridium 1½–2 inches in diameter. This differs from the preceding species in being soft, flaccid, and soon collapsing; it, no doubt, is not so persistent. Microscopically it is readily distinguished by its much larger threads. I have no knowledge of *B. obovata*, Massee, described in the Journal of Botany, Vol. XXVI., p. 134, and said to come from New Mexico.

b. Peridium with a regular apical mouth, the spores with long pedicels.

3. B. NIGRESCENS, Pers. Peridium subglobose, with a fibrous mycelium. Cortex a thin, smooth, white continuous layer, at maturity breaking up into scales, which soon disappear; inner peridium thin, flaccid, becoming dark-brown, smooth and shining, dehiscent at the apex by a lacerate mouth. Mass of spores and capillitium soft, lax, at first ochraceous or olivaceous, at length purplish-brown; the threads flexuous, about 1 mm. in extent, three to five times branched, the main stem 12–18 mic. thick, the ultimate branches tapering; spores globose or oval, even, 5–6 mic. in diameter, with long hyaline pedicels.

Growing in old pastures, in fields and woods Canada, *Saccardo;* Pennsylvania, *Schweinitz;* North Carolina, *Curtis;* Ohio, *Lea;* California, *Harkness.* Peridium 1–2 inches in diameter. I have never succeeded in obtaining an American specimen of this species; my description is drawn up from European specimens.

4. B. PLUMBEA, Pers. Peridium depressed-globose, with a fibrous mycelium. Cortex a thin, smooth, white continuous coat, loosening at maturity and shelling off, except sometimes a small portion about the base; inner peridium thin, tough, smooth, lead-colored, dehiscent at the apex by a round or oblong aperture. Mass of spores and capillitium soft, lax, ochraceous or olivaceous, then purplish-brown, the threads .8–1.0 mm. in extent, three to five times branched, the main stem 12–16 mic. thick, the ultimate branches long, straight and tapering to a fine point; spores oval, even, 6–7 by 5–6 mic., with long hyaline pedicels.

Growing on the ground in meadows and pastures. New England, *Frost;* New York, *Peck;* Pennsylvania, *Schweinitz;* Carolina, *Curtis;* Ohio, *Morgan;* Indiana, *Gentry;* Wiscon-

sin, *Trelease:* California, *Harkness.* Peridium ¾–1¼ inches in diameter. I have never seen specimens with globose spores. and probably our plant is referable to *B. ovalispora*, Cke. & Mass. I have described it under the name by which it has always been known in this country.

5. B. MINOR, Morg. n. sp. Peridium subglobose, deeply sunk in the soil and connected with it by a filamentous mycelium, which issues from every part of the surface. Cortex thickish, rough and irregular from the adherent soil, fragile, falling away at maturity, except sometimes a small portion about the base; inner peridium thin, smooth, flaccid, reddish-brown, dehiscent by a regular apical mouth. Mass of spores and capillitium olivaceous, then reddish-brown; the threads curled and flexuous, with an expanse of 1.0–1.5 mm., two to four times branched, the main stem 10–15 mic. thick, the ultimate branches very long and tapering to a fine point; spores globose or slightly oval, even, 3.5–4.5 mic. in diameter, with long hyaline pedicels. See Plate V., Figs. 10, 11, 12.

Growing in damp shaded situations. Ohio, *Morgan;* Nebraska, *Webber.* Peridium ½–¾ of an inch in diameter. A species well marked by its peculiar habit. The curled and flexuous threads are interesting microscopic objects.

Genus XIII.—MYCENASTRUM, Desv.

Mycelium funicular, rooting from the base. Peridium subglobose, without a thickened base; cortex a smooth continuous layer, at first closely adnate to the inner peridium, after maturity gradually breaking up and falling away; inner peridium thick, tough, coriaceous, becoming hard, rigid and corky, the upper part finally breaking up into irregular lobes or fragments. Capillitium originating within the tissue of the gleba; the threads free, short, thick, with a few short branches, acutely pointed and with scattered prickles; spores large, globose, sessile, brown.

Puff balls of considerable size, growing in the sandy soil of dry regions. A very distinct genus, in no way related to Scleroderma, and resembling it only in its thick, corky, inner peridium. The threads of the capillitium originate within the tissue of the gleba, along with the spores, and are set free by deliquescence, the same as in Bovista.

1. M. SPINULOSUM, Peck. Peridium globose, depressed globose, sometimes elongated and often irregular, with a thick, cord-like root. Cortex at first a thickish, white, smooth, continuous layer; after maturity it cracks or becomes furrowed into large polygonal areas, and at length falls away in large flakes or scales; inner peridium very thick, at first white and coriaceous, becoming hard, dry, brown and rigid, the upper part finally breaking up into irregular lobes or fragments. Mass of spores and capillitium compact, then friable, at first olivaceous, then dark purplish-brown; the threads bent, curved and flexuous, subhyaline, .2–.7 mm. in length, about the same thickness as the spores, with a few short branches, and with scattered prickles, which are most abundant toward the acute extremities; spores globose, very minutely warted, opaque, 9–12 mic. in diameter, often with a minute or slender hyaline pedicel. See Plate V., Figs. 13, 14.

Growing on the sandy soil of the western prairies. Wisconsin, *Brown;* Dakota, *Ellis;* Nebraska, *Webber;* Colorado, *Trelease;* Kansas, *Kellerman, Cragin;* New Mexico, *Irish.* Peridium 2–4 inches in diameter. The plants are said to grow together in groups, sometimes of many individuals; after maturity they are easily loosened from their place of growth, and are then rolled about by the wind. It has been stated that Prof. Peck's name is a synonym for *M. corium,* Desv., but it is not clear what this species is. In Saccardo's Sylloge the diameter of the spores is given as 8 mic., in Grevillea XVI., p. 33, Dr. Cooke gives their diameter as 15 mic.; neither of these measurements apply to our plant. So far as description goes, our plant appears to be the same as the South American *M. chilense,* Mont. Montagne states that he compared his plant with an authentic specimen of *M. corium* from Desvaux, and that they differed in the color and appearance of the capillitium and mode of branching of the threads. With abundant specimens from widely different regions of the west, I have been unable to detect but this single species.

MANUAL OF THE PALEONTOLOGY OF THE CINCINNATI GROUP.

By Joseph F. James, M. Sc., F. G. S. A.

PART II.

(Continued from Vol. xiv, p. 72).

CŒLENTERATA.

An extensive sub-kingdom, comprising a great variety of forms in both a living and a fossil state; widely scattered over the world and found in all geological formations from the most ancient to the most recent.

It is divided by Nicholson* into two classes, HYDROZOA and ANTHOZOA, and these again are divided into sub-classes. Both classes are represented by fossils in the Cincinnati group.

The CŒLENTERATA show a considerable advance over the PROTOZOA, there being present a simple or divided cavity, which acts as an alimentary tract, and which is sometimes divided into two parts. The body wall consists of two layers, an "ectoderm" or outer skin, and an "endoderm" or inner skin. Between these, an intermediate layer, "mesoderm," is usually developed.

Thread cells, possessed of peculiar stinging powers, are present. They are provided with long lasso-like filaments, that lie coiled up in the cells when at rest, but are shot out rapidly when a necessity arises for their use. The tip of the lasso is furnished with a number of barbs or hooks, by means of which the "sting" is inflicted. A nervous system is generally developed. Reproductive organs are present, but a-sexual reproduction, (budding or gemmation) also takes place. (See Nicholson, as above, and T. Rymer Jones, "Animal Kingdom," 4th edition, pp. 57–59, for fuller details.)

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*Manual of Palentology, vol. I, 1889, pp. 190–191. I am also indebted to this same author for most of the account of the sub-divisions of this sub-kingdom, which follows.

Class.—Hydrozoa.

This class comprises those Cœlenterates in which the walls of the body enclose a simple undivided cavity. No æsophageal tube is present, but the upper end of the alimentary tract may be prolonged into radiating canals united by a peripheral ring. The reproductive organs are external buds, often developed into specially modified zooids. (Nicholson, Ibid, p. 192.)

The simplest living type is the fresh-water *Hydra*. In this, as in all the other members of the class, the ovum gives rise to a "polypite," often capable of throwing out buds. These generally remain attached to the parent "zooid," and a compound organism is produced. Frequently the zooids are differentiated into two sets; the members of one of these supply the food, while the others act as the reproductive bodies of the colony. These last are termed "gonophores," and may remain attached to or become free from the parent. The colonies are either free or attached by a modified end. The ectoderm frequently secrets a chitinous or calcareous outer layer, that may cover only the fleshy stem or "cœnosarc," or be extended into little cups or "hydrothecæ." When these last are present the body of the polypite is contained within the cup, while the tentacles are protruded from the open end.

But few genera of this class are preserved in a fossil state, though great numbers are now found in the oceans. The bodies are generally soft and illy-adapted for preservation; and although certain of these soft bodied animals (*i. e. Medusæ* or jellyfish) are supposed to have left impressions on the rocks, generally only those secreting a horny, chitinous or calcareous skeleton have been preserved.

Three sub-classes are represented in the Cincinnati Group in Ohio. These are Hydroida, Graptolitoidea and Stromatoporoidea. The features of these sub-classes are given under their respective heads.

Sub-class Hydroida.

A single order, Thecaphora, is represented. The general features are: organism attached or at least capable of attachment; branching and plant-like, consisting of numerous

polypites united by a common stem or "cœnosarc;" outer covering chitinous or corneous, investing the cœnosarc, and prolonged into hydrothecæ.

To this order two genera, generally classed under Graptolites, are referred by Nicholson. They are *Dendrograptus* and *Dictyonema*, and are readily distinguished from each other. In the first the stem is branching and plant-like; in the second it forms a reticulated net-work. The two genera differ mainly from the true Graptolites by having a base for attachment, the typical GRAPTOLITOIDEA lacking this.*

Genus 1.—DENDROGRAPTUS, Hall, 1862.

Fronds simple or aggregate, consisting of a strong foot-stalk, sometimes furnished below with a distinct root, or root-like bulb, and above variously ramified and divided into numerous branches and branchlets, slightly divergent; the whole thus appears shrub-like; fronds some times flabellate (?); branches celluliferous on one side; cellules appearing sometimes as simple indentations on the surface, sometimes distinctly angular, with conspicuous denticles; substance of stipe and branches corneous; solid or tubular; surface striated; the denticles are sometimes absent from some branches. (Hall, Geol. of Wisconsin, vol. 1, 1862, name only, p. 21. Grap. of Quebec Group. Can. Organic Remains, Decade II, 1865, p. 126; Nicholson, Mon. of Brit. Graptolitidæ, pt. 1, 1872, p. 127. *Buthotrephis* in part. *Psilophyton* in part.)

Remarks—This genus was first proposed in the Geology of Wisconsin, as noted above, but it does not seem to have been described until 1865, when the "Graptolites of the Quebec Group" was published. It is probable that the species described by Hall as *Buthotrephis gracilis* is really a graptolite, and there is no doubt in the mind of the writer that *Psilophyton gracillimum*, Lesqx., is really one.

1. D. GRACILLIMUM, Lesqx. (sp.) 1877.

"Stem very slender, dichotomously branched, smooth or naked half round, slightly channeled in the length, branches numerous, of various length, filiform." (Am. Phil. Soc.,

*For numerous references and notes in the portion which follows I am indebted to Dr. R. R. Gurley, of the U. S. Fish Commission. He has been engaged for several years past in the study of the group of Graptolites.

Proc., vol. 17, 1877, p. 164, as *Psilophytum gracillimum*, Lesqx.)

Locality.—Cincinnati, in bed of Crawfish creek; Kentucky, in bed of Licking river.

Remarks.—The above species was originally described as a land plant belonging to the genus *Psilophyton* of Dawson. It is, however, associated with marine organisms, and can scarcely be considered as of any other than animal origin. Walcott notes this fact in his paper on "Fossils of the Utica Slate" (advance paper of Albany Institute Trans., vol. 10, 1879, p. 21), where he says: "Their occurrence with algæ, graptolites, trilobites and brachiopods in the same layers of shale, in a position indicating their growth *in situ*, taken with their graptolitic structure, precludes the idea of their being of other than marine origin." The specimens as found at Cincinnati are generally greatly broken up, and occur in a soft, blue clay, with stems of crinoids, brachiopoda, etc. The species greatly resembles *D. tenuiramosus* and *D. simplex*, Walc., from the Utica slate, and *D. gracilis* Hall, from the "Quebec" group. A form of *Buthotrephis* (*B. gracilis* Hall) is also very similar to this, and appears to be distinct from other forms referred to the same species. (See Paleontology of N. York, vols. 1 and 2, 1847, 1852).

2. D. TENUIRAMOSUS, Walcott, 1879.

Stipe slender, compressed; branches bifurcating irregularly, frequently subdividing, terminating in filiform extremities; surface apparently smooth; celluliferous side with smooth, simple, round pits or depressions along the center of the branches; substance corneous, and probably tubular. (Separate from Trans. Albany Insti., vol. 10, 1879, p. 10).

Locality.—Cincinnati, Ohio.

Remarks.—This species was originally described from the Utica slate of New York, but it also occurs in the Cincinnati group. Ulrich gives its horizon as between low water in the Ohio at Cincinnati and 200 feet above. A specimen in the collection of the late Mr. U. P. James shows all the characters of the species. It is closely related to *D. gracillimum* and occurs at about the same horizon at Cincinnati.

Genus 2.—Dictyonema, Hall, 1852.

Fronds circular, flabelliform, funnel-shaped or conical, sometimes arranged in groups composed of radiating branches, which frequently divide, but run nearly parallel with one another; all the branches united by delicate transverse bars or dissepiments; cellules forming distinctly angular denticles, arranged on the sides of the branches in an alternate manner; frond rooted (?); substance corneous. (Palentol. of New York, vol. 2, 1852, p. 174. *Emend.*, Nicholson, Mon. Brit. Graptolitidæ, 1872, p. 129.)

Remarks.—The genus was originally described by Prof. Hall as a coral, the type species occurring in the Niagara Group. Prof. Hall noticed its resemblance to the Graptolites, however, and in 1857 referred the genus to that family.* Only a single species has been recorded from the vicinity of Cincinnati. This has been generally referred to as *D. irregulare*, but Dr. Gurley says it is not that species as it occurs in New York. He places it in the species as given below with the accompanying comments.

1.—D. arbusculum, Ulrich (sp.) 1879.

"Frond small, originating in a single stipe at the base, branching and spreading above; branches varying in size, but narrow, not exceeding two-one-hundredths of an inch in width, with strong, prong-like projections rising from the sides at variable intervals; bifurcations numerous; surface with faint longitudinal or diverging corrugations irregularly distributed; free extremities of branches usually pointed. (Jour. Cin. Soc. Nat. Hist., vol. 2, 1879, p. 28; as *Inocaulis arbuscula*.)

"To this description I add the following from an examination of specimens in the cabinet of the late Mr. U. P. James:

"Specimens consisting of a portion of the network, showing it to be formed principally by the curving toward each other of adjacent branches, dissepiments, however, being present. In consequence of the curvilinear direction of the branches the meshes have a rounded-oblong, or rounded-diamond shape. Branches varying in thickness, but about two-

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*In the Rept. Prog. Can. Surv., 1857, p. 142, where *Graptopora*, Salter was noted as a synonym. Hall also records the discovery of hydrothecæ "cellules" and modifies the original description to include these. R. R. G.)

one-hundredths of an inch or more. Length several times the breadth, so that the spaces are frequently long and narrow.

"*Locality.*—Covington, Ky., 150 feet above low water in the Ohio River; run emptying into the Little Miami River, near Symmes Station, on the Cincinnati, Washington and Baltimore R. R.

"*Remarks.*—Mr. Ulrich informs me that a study of better material than that upon which his original description was based has convinced him of the identity of three species enumerated in his 'Catalogue of Fossils occurring in the Cincinnati Group,' 1880, p. 6. These are *D. irregulare*, Hall (U. P. James), *Dictyograptus reticulatus*, Ulrich, (named, but not described) and *Inocaulis arbuscula*, Ulrich.

"In the cabinet of the late Mr. U. P. James are two specimens identified by him as *D. irregulare*, Hall. A comparison of these with Mr. Ulrich's figure of *Inocaulis arbuscula* seems to rather favor his views of the identity of the two forms. I may also add that the species is undoubtedly a *Dictyonema*, and it is distinct from the Calciferous form. Specimens of the latter from the type locality show the branches more angularly bent, so the meshes are more nearly rectangular; whereas in the present form the branches are more slender and more roundly curving, thus making the interspaces rounded diamond shape."

In the original description Mr. Ulrich compares his species to *Inocaulis bellus*, H. & W., from the Niagara. J. W. Spencer says (Bull. Mus. Univ., Missouri, No. 1, 1884, p. 13) that it "resembles and is probably a species of *Calyptograptus*," a new genus proposed by himself (Can. Nat., new ser., vol. 8, 1878).

The original description of *D. irregulare*, Hall, is as follows: "Frond spreading, diffuse, branches lax, frequently bifurcating; bifurcations unequal; branches equal to one-half the usual width of the interspaces, or a little less; connecting filaments generally slender, expanding with their junction with the branches. Fenestrules extremely irregular in form and proportions, varying from a width greater than the length, to a length three or four times as great as the width; those with a length and breadth nearly equal, often appear hexagonal. Near the base of the frond the fenestrules are sometimes elongate and triangular. Cellules undetermined.

Surface without distinct organic markings. Branches arranged in the proportion of from 25 to 28 in the space of an inch." (Canadian Organic Remains, Decade II, 1865, p. 136).

Sub-class GRAPTOLITOIDEA.

Hydrozoa, in which the hydrosoma is compound and free, consisting of numerous polypites united by a cœnosarc, the latter being enclosed in a strong tubular polypary, while the former are protected by hydrothecæ. The polypites not separated from the cœnosarc by any partition, and the polypary generally supported by a chitinous rod or solid axis. (Nicholson, Monograph Brit. Grapto., 1872, p. 99. See also for a full explanation of the features of various members of the sub-order, Manual of Paleontology, Nicholson, vol. 1, 1889, pp. 210–222).

Remarks.—In this sub-class are included the majority of the Graptolites. The limited number of species known from Cincinnati scarcely justifies an elaborate classification, but the key presented below is perhaps as natural a one as can be given with our present knowledge of the more obscure forms.

Key to Genera.

a. MONOPRIONIDÆ—*i. e.*, polypary with cells on one side only.

1. Graptolithus—Polypary simple and unbranched.

b. DIPRIONIDÆ—*i. e.*, polypary with cells on both sides.

2. Diplograptus—Cell mouths at the end of projecting denticles.

3. Climacograptus—Cell mouths apparently sunk beneath the substance of the stipe.

4. Dicranograptus—Cell mouths as in No. 3; the main stem with cells on both sides; the branches with cells on one side only.

c. MULTIPRIONIDÆ—*i. e.*, with many cells, without definite arrangement.

5. Megalograptus—Cell scattered over polypary, but not on margin.

d. INSERTÆ SEDIS—*i. e.*, of uncertain position.

6. Inocaulis—Cells unknown; branched and rough, generally in groups.

7. Dawsonia—Polypary unknown; ovoid bodies supposed to be ovarian capsules.

Genus 1.—Graptolithus, Linn, 1768.

Polypary simple, linear, commencing with a more or less attenuated, generally curved base, and possessing only a single row of cellules on one side; the cellules generally overlap to a greater or less extent, and are never separated by non-polypiferous portions of common canal. (Emend, Nicholson, Mon. Brit. Grap., 1872, p. 101, as *Graptolites*).

Remarks.—Nicholson notes that the above definition does not correspond to the original one of Linnæus, nor to the later definition of Hall. It is made to include, however, those forms that in an adult condition have only a single row of cellules on one side. The two species commonly referred to this genus from the Cincinnati group are *G. gracilis* and *G. subtenuis*. As regards the genus itself Dr. Gurley says:

"*Graptolithus* has practically been abandoned; because, first, it was established for, and as at first defined included, only *inorganic* objects (*Dendrites*, etc.), and second, it has been used for everything until it now means nothing. When used at all by the latest writers, it is in the sense of the *exclusively* Upper Silurian *Monograptus*."

In regard to the form identified as *G. gracilis*, from Cincinnati, Dr. Gurley says: "So far as can be determined from the material I have seen, the specimens identified as *Graptolithus gracilis*, Hall, and *Dendrograptus gracillimum*, Lesqx., seem much alike. I judge, however, from single specimens of each, and these leave much to be desired. The only criteria are the thickness and general aspect of the branches, which seem much the same. This *gracilis* bears no relation to *Stephanograptus gracilis*, from Norman's Kill, New York, which is the only '*Graptolithus gracilis*' Hall described. Better specimens might show different features, but probably that called *G. gracilis* is *Dendrograptus gracillimum*, Lesqx. *Dendrograptus gracilis*, Hall, is, I think, Calciferous, which is strong presumptive evidence against the reference of the Cincinnati form to that species."

In regard to *G. subtenuis*, Hall, and *G. tenuis*, Portlock, Dr. Gurley writes: "Portlock's species is *Monograptus tenuis* of the Upper Silurian. To it has been referred almost every species which was slender and had the thecæ confined to one side. The American species that has been referred to it is

Leptograptus (*Graptolithus*) *sub-tenuis*, Hall (sp). This is a Norman's Kill, New York, form, and I should doubt very strongly its presence in the Cincinnati group. There can be no question whatever as to the distinctness of Portlock's and Hall's species, and I strongly suspect the Cincinnati form is referable to neither."

Upon this authority, therefore, what has been called at Cincinnati *G. gracilis* is referred to *Dendrograptus gracillimum*, (which see *ante*); and *G. sub-tenuis* is dropped altogether.

Genus 2.—DIPLOGRAPTUS, McCoy, 1854.

Polypary composed of two simple, monoprionidian stipes, united back to back, their dorsal walls uniting to form a median septum, along the center of which runs the solid axis; cellules alternating with one another on the two sides of the frond, the cell mouths being situated at the end of projecting denticles; base usually furnished with a radicle, and the solid axis probably always prolonged beyond the distal end of the polypary. (Nicholson, Mon. Brit. Grap., 1872, p. 115).

Remarks.—McCoy's original description of this genus consists of the statement that he restricts *Graptolithus* to those species having cells only on one side. For those with cells on both sides he proposed *Diplograpsus* [now *Diplograptus*]. (Brit. Pal. Foss., 1854, p. 3).

Of the two species commonly referred here, one (*spinulosus*) has been placed in the genus *Glossograptus*. The other (*Whitfieldi*) remains with the genus. Both are, however, here retained in *Diplograptus*, as I can not see the justice of separating the two species. *Glossograptus* was defined as follows: "Column free; thin membranaceous, ligulate, extremities rounded, axis distinct." (Emmons, Amer. Geology, pt. 2, 1856, p. 108).

1.—D. SPINULOSUS, Hall, 1859.

Stipe simple, flat; sides sub-parallel, gradually expanding from the base, which is furnished with several minute setiform radicles; serratures not distinct, the margins sinuous; the principal parts extended into slender, spiniform processes. These spinules are about one-sixteenth of an inch apart. (Paleont. of New York, vol. 3, 1859, p. 517.)

Locality.—Cincinnati, O.

Remarks.—Dr. Gurley remarks that this species is doubtfully distinct from *Glossograptus ciliatus*, Emmons. The description of the latter species is as follows: "Straight linear crenulations faintly developed and prolonged into ciliæ, equal in length to the width of the ligulate body; ciliæ surrounding the whole body or membrane. The axis is prolonged beyond the membrane, forming the column or stem. Length one inch." (Emmons, *loc. cit.*, p. 108).

2.—D. WHITFIELDI, Hall, 1859.

Stipe simple, flat, gradually expanding from the base to near the middle of its length, the upper part gradually narrowing in the direction of the apex, rarely continuing of the same width above the middle; serratures shallow, angular; the upper margin of the denticle short and nearly rectangular to the axis, the lower side twice as long as the upper, the tips furnished with mucronate or short setiform extensions which project in a line with the upper margin of the denticle. Serratures from 22 to 28 in one inch. Length one to one and a half inches. (Paleont. of New York, vol. 3, 1859, p. 516).

Locality.—Cincinnati.

Remarks.—Dr. Gurley says the occurrence of this species at Cincinnati is doubtful, as it, like the previous one, is a "sub-Utica" form in New York. It is also possible, he thinks, that both may be errors for *quadrimucronatus*, Hall, a "Utica" species.

Genus 3.—CLIMACOGRAPTUS, Hall, 1865.

Polypary composed of two simple, monoprionidian stipes united back to back, their dorsal walls coalescing to form a median septum, in the center of which runs a solid axis, the cellules so welded together that their mouths appear as if sunk below the general surface of the polypary; solid axis prolonged beyond the distal extremity of the frond, and usually beyond its proximal extremity as well. (Hall, Grap. Quebec Group. Can. Organic Remains, Decade II, 1867, p. 111. Nicholson, *loc. cit.*, 1872, p. 117).

Remarks.—Though originally described by Hall, the above description is that given by Nicholson. It differs somewhat in terminology from Hall's description, but the characters are the same. Two species of the genus have generally been

credited to the Cincinnati rocks. *C. bicornis* and *C. typicalis.* Dr. Gurley informs me that in New York the former very rarely ranges above the lower Trenton, and that probably the Cincinnati forms heretofore referred to this species should be called *C. typicalis.* The two descriptions are, however, inserted here for comparison.

1.—C. BICORNIS, Hall, 1847.

Stipe linear, elongated, compressed, narrow, gradually widening from the base upwards; one line or less wide; serrated on both sides; serratures slightly oblique; teeth about one-half the width of the stipe, obtuse; axis capillary; base bifurcate, slit extending about one-half way to the axis; about one-half as thick as wide, round on one side, flat on the other, often covered with carbonaceous material. (Pal. of New York, vol. 1, 1847, p. 268, as *Graptolithus bicornis*).

Locality.—Cincinnati (?).

Remarks.—For remarks on this species see under the generic description above.

2.—C. TYPICALIS, Hall, 1865.

Stipe linear, serrated on both sides; orifices sunk beneath the surface of the polypary, transversly oval, or, when flattened, rectangular or slightly oblique and semi-oval; axis filiform, central or sub-central and apparently solid; cellules joined to the axis at the base, the cell partitions consisting of triangular plates, with an unequal arching or convex upper surface, and a concave lower surface; at the base of the cellules and along the entire length of the stipe is a longitudinal depressed line.

Locality.—Cincinnati.

Remarks.—This species, while named by Hall in 1865 in Canadian Organic Remains, (Grap., of Quebec Group,) 1865, p. 57, and explanation of plate A, is not expressly defined by him. Consequently the description above given has been compiled from remarks made in the course of the discussion of *C. bicornis* on pages 29–30. On plate A nine figures of the species are given. Nicholson rather questions the absence of a vertical septum in this species, saying it is certainly present in the type species of the genus, and in all others examined

by him. "If it should be proved," he says, "that such a vertical septum is truly wanting in *C. typicalis*, Hall, a new genus must, I think, be established for its reception." (See Mon. Brit. Grap., 1872, p. 118).

Genus 4.—DICRANOGRAPTUS, Hall, 1865.

Polypary having its proximal portion diprionidian, but dividing distally into two monoprionidian branches, which have cellules on their outer aspect only; cellules so welded together that their mouths appear as if sunk below the general surface of the polypary; solid axis prolonged proximally as a minute radicle, flanked by two minute lateral spines. (Nicholson, Brit. Grap. *loc. cit.*, p. 119).

Remarks.—In this case, as with *Climacograptus typicalis*, no definite description is given by Hall on the original proposal as the name. (Canadian Organic Remains; Grap. of Quebec Group, 1865, p. 112). The description given above is, therefore, taken from Nicholson's Monograph. But one species has been recorded from the Cincinnati group, given below.

1.—D. RAMOSUS, Hall, 1847.

Stipe linear, narrow, about one line wide, compressed, serrated on both sides, except branches; teeth obtuse, distant, somewhat narrowed toward the base, more than one-half the width of the stipe; stipe bifurcating or ramose; branches linear, serrated only on outer margin. (Pal. of New York, vol. 1, 1847, p. 270, as *Graptolithus ramosus*).

Locality.—Cincinnati.

Remarks.—This species, under the name of *Graptolithus ramosus*, is frequently mentioned in Hall's "Graptolites of the Quebec Group." Nicholson also refers to it (Mon. Brit. Grap., 1872), and gives an excellent figure.

Genus 5.—MEGALOGRAPTUS, S. A. Miller, 1874.

Stipe large, cylindrical or sub-cylindrical; surface covered with cells; fronds with spinous processes on the margins; carbonaceous film covering one side. (Cin. Quart. Jour. Science, vol. 1, 1874, p. 343).

Remarks.—This is quite an anomalous genus, being entirely distinct from any other known graptolite. Its position in any system of classification is as yet undetermined. Only one species is known.

1.—M. WELCHI, Miller, 1874.

Surface of polypary smooth, mostly covered with cells immersed in the body of the frond; openings circular, about one thirty-second of an inch in diameter and one-sixteenth of an inch apart; cellules not extending to the edge of the polypary, but ceasing about one-quarter of an inch from the edge; numerous spines borne on the edges of the frond, varying from one-quarter to one-half an inch in length, sharp and sometimes branched; frond divided into sections by transverse constrictions, each section bearing from two to four spines; spines probably originally round, but flattened by compression; whole surface, when well preserved, covered by a black, carbonaceous film, the cell openings only lacking this. (Ibid, pp. 343–346).

Locality.—Clarksville, Clinton County, Ohio.

Remarks.—As noted above, there is only one species in this genus. No one has written upon it except Mr. Miller. In his "North American Geology and Palæontology" (1889), his original figures are reproduced, but no new information is given.

Genus 6.—INOCAULIS, Hall, 1852.

Frond composed of numerous flattened, corneous or scabrous bifurcating stems, having a fibrous or plumose structure. (Pal. of N. Y., vol. 2, 1852, p. 176).

Remarks.—This is also an anomalous genus, and its position in the order is very uncertain. No cellules are known in any species referred to it. In a previous paper (Fucoids of the Cincinnati Group, this JOURNAL, vol. 7, p. 164), by the writer, it is suggested that a form described by Miller and Dyer as *Licrophycus flabellum* should be referred to the present genus. It is evident, however, that this was an error. The species in question is more likely the burrow of an annelid. Only one species has been referred to this genus from the Cincinnati group. It is here referred to the genus *Dictyonema* as *D. arbusculum*, which see (ante).

Genus 7.—DAWSONIA, Nicholson, 1873.

Horny or chitinous capsules of a rounded, oval, conical, or campanulate shape, furnished in most cases with a little spine or mucro, and having a marginal filament exactly resembling the solid axis of a graptolite. The marginal fiber sometimes complete, sometimes ruptured opposite to the mucro. The mucro sometimes apparently wanting, sometimes marginal, sub-marginal, sub-central or central. The surface smooth or concentrically striated. (Annals and Mag. Nat. Hist., 4th ser., vol. 11, 1873, p. 139). *Lockeia*, U. P. James. The Paleontologist, 1879.

Remarks.—The above name was proposed by Dr. Nicholson for certain bodies found associated with graptolites in Scotland and in Canada, which he considered the ovarian capsules of graptolites of different species. The generic name, *Lockeia*, was proposed for similarly shaped bodies found at Cincinnati, and supposed to be the remains of marine plants. There can be no question that the bodies under consideration are not plant remains. Their resemblance to figures and descriptions of *Dawsonia* cause them to be considered as synonymous with that genus. I find, however, that in 1868, Dr. Dawson refers as follows to a species of trilobite. After describing *Microdiscus dawsoni*, Hartt, he says: "Mr. Hartt had originally described this species under the new generic name of *Dawsonia*, but Mr. Billings regards it as a species of *Microdiscus* of Salter." (Acadian Geology, 1868, p. 655). Whether under these circumstances the name *Dawsonia* was pre-occupied by Hartt is a question to be decided by others. In case it be decided in the affirmative, it is evident that *Lockeia* must be used. For the present we shall use *Dawsonia*, Nicholson. The description of *Lockeia* is as follows: Elongated, convex, obtuse or sharp-pointed bodies, seed-like in appearance, slightly attached to the surface of the rock, with or without a longitudinal depression. (The Paleontologist, 1879, p. 17). Only one species is known from these rocks, as given below.

D. SILIQUARIA, U. P. James (sp.) 1879.

Convex, elongated elevations from one-eighth to one-half an inch long, one-half to one and one-half lines broad at base, and one-half to one line high in center; sloping and tapering

to sharp or more or less obtuse ends; rounded or sharply ridged longitudinally; scattered over the surface of the rock

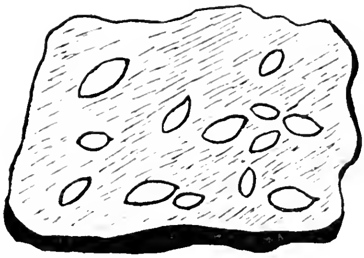

FIG. 7.—*Dawsonia* (*Lockeia*) *siliquaria*. Nat. size. Original.

irregularly, sometimes in the form of a star, one in the center and five others placed quite regularly around it with their longer axis pointing inward; again they lie in groups or overlie one another: The specimens have been likened to grains of wheat.

Locality.—Ohio River bank, near Ludlow, Ky., between low and high-water mark.

Remarks.—Placing these bodies with graptolites is, of course, purely conjectural. They do not present any carbonaceous appearance, but from their resemblance to some forms of *Dawsonia*, it seems evident that they belong to that genus, whatever place it may be considered to occupy.

[TO BE CONTINUED.]

DESCRIPTION OF SOME SUBCARBONIFEROUS AND CARBONIFEROUS CEPHALOPODA.

By S. A. Miller and Charles Faber.

(Presented January 5, 1892.)

Goniatites missouriensis, n. sp.

Plate 6, Fig. 1, side view, natural size.

Shell medium size, subglobose, rounded on the dorsum. Umbilicus large, abrupt, deep and showing very little of the inner whorls. Volutions few, increasing rather rapidly in size, broadly rounded upon the sides of the inner whorls, but more and more flattened laterally as the body chamber is approached; transverse diameter of the inner whorls equal to or greater than the width from the dorsal to the ventral side, but near the aperture the dorso-ventral diameter is twice as great as the transverse. Volutious profoundly grooved within for the reception of the inner whorls. Our specimen reveals only the septate portion, and hence the body chamber and aperture are unknown.

Septa close, fairly crowded and deeply sinuous. There are three lobes and three saddles on each side. The saddles are linguiform, being regularly rounded, at the ends, and the superior ones being longer than the inferior ones or those nearer the umbilicus. The lobes are lanceolate, as long as the saddles, and sharply pointed at the extremities, which hug closely the saddles on the superior side. Dorsal lobe and saddle not determined.

The general form, closely crowded septa, and direction of the extremities of the lobes toward the superior saddles will distinguish this species from all others.

Found on Brush Creek, in the Upper Coal Measures, near Kansas City, Missouri, and now in the collection of Charles Faber.

GONIATITES SCIOTOENSIS, n. sp.

Plate 6, Fig. 2, side view, natural size; Fig. 3, dorsal view with anterior end turned downward, and showing radiating furrows curving backward over the dorsum.

Shell medium, or rather above medium size; somewhat lenticular in form, obtusely rounded on the dorsum. Umbilicus consisting of a shallow, funnel-shaped fossette, without exposing any of the volutions. Volutions few, rapidly enlarging the outer ones profoundly grooved for the reception of the inner ones, and depressed convex on the sides. The greatest transverse diameter is at the margin of the umbilical fossette, and it is about two-thirds the dorso-ventral diameter. Seven furrows radiate from the margin of the umbilicus on each side, curve gently forward at the superior lateral sides and then curve more abruptly backward across the dorsum, as shown in our specimen. Probably, if the specimen was perfectly preserved, it would show eight of these radiating furrows. Surface between the furrows showing traces of finer similarly sinuous lines. Body chamber and aperture unknown.

The sinuosities of the septa, as near as they can be determined from our specimen, may be described as follows: Dorsal lobe lanceolate and pointed, superior lateral lobes longer than the dorsal, and pointed at the extremities; dorsal saddle sublinguiform, gradually narrowing and rounded at the extremity, lateral saddles similar in outline, the three inferior lobes short with corresponding saddles.

The lenticular form, funnel-shaped umbilical fossette, and the surface markings, including the radiating furrows, will distinguish this from all other species.

Found above Sciotoville, on the Ohio River, in rocks usually classed with the Waverly Group, but they are above the Waverly sandstone proper, and probably belong to the upper part of the Subcarboniferous system. The specimen described belongs to the collection of Charles Faber.

GONIATITES OCCIDENTALIS, n. sp.

Plate 6, Fig. 6, lateral view, natural size: Fig. 7, dorsal view, showing end of siphuncle at the upper margin and two spots where it is broken into on the dorsum, a radiating furrow and the outlines of two septa crossing the dorsum.

Shell below medium size, globose, broadly rounded on the dorsum, or rather semi-circular from the margin of the umbilicus on one side to the margin of the umbilicus on the other. Umbilicus large, abrupt, deep, exposing very little of the inner whorls. Volutions very gradually enlarging, the outer ones profoundly grooved for the reception of the inner ones; transverse diameter one half greater than the dorso-ventral diameter. Four broad, shallow, indistinctly defined furrows radiate from the umbilicus and pass straight across the dorsum. Surface between the furrows marked with fine transverse lines, and having the border of the umbilicus crenated or subnodose. Siphuncle small and close to the shell on the outer margin. Body chamber and aperture unknown. Septa form a sigmoidal flexure in crossing the dorsum, with a single angular lateral lobe.

The general form, surface markings, including the radiating furrows, and sigmoidal flexure of the septa on the dorsum, will distinguish this from all other species.

Found in the Coal Measures, on Elkhorn Creek, Kentucky, and now in the collection of Charles Faber.

GONIATITES LIMATUS, n. sp.

Plate 6, Fig. 8, lateral view, natural size; Fig. 9, dorsal view, the fracture at the end destroys the saddles and lobes, leaving only the three inferior indentations.

Shell small, elegant, thin, discoidal, rapidly expanding in circumference, with very slight increase in thickness; sides flat and dorsum narrowly rounded. Umbilicus small, abrupt, exposing very little of the inner whorls. Volutions rapidly expanding dorso-ventrally with very little increase transversely; the outer ones fully embracing the inner ones, flattened on the sides from the umbilicus to the middle of the superior lateral saddles, from which a flat depression extends

to the margin of the rounded dorsum. Our specimen shows only the septate portion, and hence the body chamber and aperture are unknown.

Septa very close, crowded, sinuous. Dorsal lobe narrow, twice as long as wide, linguiform; dorsal saddles a little wider than the dorsal lobe, quite as long, linguiform; superior lateral saddle broader than the dorsal, gradually contracting and rounded at the extremity; lateral lobe obtusely angular.

The thin, discoidal, flattened form, depression at the superior lateral saddles, and sinuosities of the septa will distinguish this from all other described species.

Found in the St. Louis Group, at Crab Orchard, Kentucky, and now in the collection of Charles Faber.

Goniatites leviculus, n. sp.

Plate 6, Fig. 10, lateral view, natural size; Fig. 11, dorsal view, showing the septa on the dorsum and an end view.

Shell very small, discoid, broadly rounded on the side and dorsum forming about half an ellipse from the margin of the umbilicus on one side to the margin of the umbilicus on the other, and consisting of many volutions. Umbilicus large, abrupt, deep or open, and exposing very little of the inner whorls. Volutions numerons (four are visible in the specimen illustrated, and as many are seen in a much smaller specimen), very slowly enlarging, the outer ones profoundly furrowed for the reception of the inner ones; transverse diameter of the inner whorls greater than the dorso-ventral, but toward the aperture the dorso-ventral diameter exceeds the transverse. Our specimens show only the septate portion of the shell, and consequently the body chamber and aperture are unknown.

Septa close and moderately sinuous. Dorsal lobe about as wide as long, and arcuate at the extremity; dorsal saddles rather narrower than the dorsal lobe and sublinguiform, but spreading over the lateral borders; lateral lobe very obtuse, the septa in a side view being somewhat sigmoidal.

The form, great number of volutions, and character of the septa, will distinguish this from all other described species.

Found in the St. Louis Group, at Crab Orchard, Kentucky, and now in the collection of Charles Faber.

TREMATOCERAS OHIOENSE, n. sp.

Plate 6, Fig. 4, lateral view, natural size; Fig. 5, dorsal view, looking forward.

Shell medium or below medium size, discoidal, rather rapidly enlarging. Umbilicus broad, showing all the inner whorls and perforated in the middle. Volutions gradually increasing in size, coming in contact, without embracing, broader transversely than dorso-ventrally. The sides of the volutions are narrowly rounded, the dorsum bears a wide depressed convex keel in the central part, with a depressed sulcus or concave furrow on each side, bounded laterally by an obtuse angle. Surface ornamented with fine longitudinal lines.

Septa moderately concave and distant nearly one-fourth the transverse diameter; they arch backward in crossing the dorso-lateral furrows and slightly forward in ascending the median ridge, which they cross transversely without extending as far forward as they do on the sides of the volution. Body chamber long, continuing to gradually enlarge and bearing the dorsal keel and furrows. Aperture and siphuncle unknown.

This species most resembles *T. trisulcatus*, from which it is distinguished by being proportionally wider, transversely, more narrowly rounded on the sides of the volutions, shallower dorso-lateral furrows, and convex instead of furrowed median keel; neither do the septa extend as far forward in crossing the median dorsal ridge.

Found near Sciotoville and near the top of the hill, in rocks usually classed with the Waverly Group, but they are above the Waverly sandstone proper, and belong to the upper part of the Subcarboniferous system. The specimens examined belong to the collection of Charles Faber.

CONTRIBUTIONS TO INDIANA HERPETOLOGY.

No. 3.

By Amos W. Butler.

URODELA—THE SALAMANDERS.

Genus CRYPTOBRANCHUS, Leuckart.

1. *Cryptobranchus alleghenienis*, Daudin. Hellbender; Mud Devil. Only two published accounts of the occurrence of this species in the State have appeared, and they both upon the same authority. Both Mr. Hughes and Prof. Hay give it upon the authority of Mr. E. R. Quick (Bull. Brookville Soc. Nat. Hist., No. 2, p. 44, and this Journal, 1887, p. 60). At the time Mr. Quick gave the information upon which these notes were based, he had seen no specimens for some years. In May, 1888, he brought me a specimen of this Amphibian, which is now in my collection. This specimen was caught on a hook by Mr. H. Kohlbran, about one mile south of Brookville, on the night of May 5th. On the same day another was caught about a mile further down the river. I am confident that in 1877 there were at least two of these animals in the collection of Hanover College, and Prof. A. H. Young informs me that he thought there was such a specimen, but has failed to find it. He stated, however, that he caught a specimen of this species at Hanover Landing, on the Ohio River, in August, 1886.

Genus AMBLYSTOMA, Tschudi.

2. *Amblystoma punctatum*, L. Spotted Salamander. A specimen from Richmond, Wayne County, is in Purdue University collection (No. 269).

3. *Amblystoma jeffersonianum*, Green. Jefferson's Salamander. Rather common in the western part of Franklin County. Mr. W. P. Shannon has taken it in Decatur County.

5. *Amblystoma jeffersonianum fuscum*, Hallow. BROWN SALAMANDER. Found with the preceding among the highlands in the western part of Franklin County.

GENUS PLETHODON, TSCHUDI.

5. *Plethodon cinereus*, Green. CINEREUS SALAMANDER; ASHY LIZARD. The Winter of 1888–9 Mr. E. R. Quick brought to me a specimen of this Salamander from a spring house near Brookville.

6. *Plethodon cinereus erythronotus*, Green. RED-BACKED SALAMANDER; CHESTNUT-BACKED LIZARD. Very common in Franklin County and throughout the White Water Valley generally, where it is found in damp places, away from water, beneath logs, stones and other cover.

7. *Plethodon cinereus dorsalis*, Baird. ASHY LIZARD. A specimen from Bloomington, Ind., seems to be this species. (Coll. Indiana University).

GENUS GYRINOPHILUS, COPE.

8. *Gyrinophilus maculicaudus*, Cope. SPOTTED-TAILED SALAMANDER. This species was described by Prof. E. D. Cope in "The American Naturalist," for October, 1890, pp. 966 and 967. It is thought by some to be uncertain that this is *Gyrinophilus*, but I have preferred, for the present, so to regard it. It is a peculiar form, in several respects approaching *Spelerpes longicaudus*, and in others differing much therefrom. In 1888, at the annual meeting of the Indiana Academy of Science, the writer had occasion to speak concerning this Salamander as follows:

"It is desirable that a good series of specimens of Cave Salamanders be obtained as soon as possible, in order that the relationship of the individuals found within our State may be determined. So far as I have learned, those of the western part of the State appear to be typical *longicaudus*. But one of this kind has been found in the southeastern part of the State. The specimens from that region have the form of *longicaudus*, but instead of the lemon-yellow coloring of that form approach the reddish appearance of *ruber*, but lack the peculiar form of the latter."

At the time of a visit made by Prof. Cope to Brookville, following the meeting of the American Association for the

Advancement of Science at Indianapolis, in August, 1890, I spoke to him of the peculiarities of a form of Cave Salamander found near Brookville. They had been called *Spelerpes longicaudus*, but I was satisfied they were not that form, yet I could not satisfy myself as to their identification. He expressed a desire to see one alive, since I spoke of their bright color in life. Through the kindness of Mr. Bayard Quick, he was presented with two living specimens, and I was enabled to furnish him an alcoholic specimen from my collection. These he took with him to Philadelphia. I take the liberty of presenting Prof. Cope's remarks concerning these specimens entire, since it may be possible some, to whom this paper will come and who are interested, may not have seen the paper quoted: "The three specimens represent young, middle-aged and mature individuals, which have passed their metamorphosis. They agree nearly in their characters. They belong to a species which resembles the *Spelerpes longicaudus*, but are distinct in form, color and habits, and belong, moreover, to the genus Gyrinophilus. The premaxillary bones are of feeble structure, and the spines are distinct and widely separated, contrary to the structure of the genus Spelerpes. The mature individuals, of which Mr. Butler possesses several, are much more robust than those of *S. longicaudus*, having a short body and relatively long preaxillary region and head. With this the tail is as long as in the *S. longicaudus*, and is similarly compressed. The entire animal is larger. The color is different from that of the *S. longicaudus*. It is vermilion-red, as in *S. ruber*, and the superior surfaces of the head and body are irregularly spotted with dark brown. The sides of the tail are similarly irregularly brown-spotted, the spots not showing the least tendency to form the vertical bars characteristic of the *S. longicaudus*. The form of the series of vomerine teeth is different. Instead of commencing at the posterior border of the internal nares, they commence opposite to the anterior border of the same, and send posteriorly a short branch along the internal border of the choana, thus giving a hook-shaped outline to each series. The proportions are as follows:

"Width of head five times in length of head and body to groin. Tail one and a half times the length of the head and body. When the limbs are extended, the posterior toes reach

the distal extremities of the metacarpals. Thirteen costal folds. The width of the head is half the length to above the middle of the humerus. The canthus rostralis is distinct, though not so strongly marked as in *Gyrinophilus porphyriticus*. Total length, 152 mm.; length to angle of mouth, 8 mm.; to axilla, 23 mm.; to groin, 53 mm.; to extremity of vent, 62 mm.

"In the adult specimens the subnareal processes are quite prominent. In young specimens the ground-color is yellower than in those of medium and full size.

"I propose to call this species *Gyrinophilus maculicaudus*. In its habitat in cold springs, it resembles *Spelerpes ruber*, with which it agrees in color. The *S. longicaudus* is a terrestrial species. The first specimens of *G. maculicaudus* were found by Mr. E. R. Quick, of Brookville, Indiana."

This species is only known from Franklin County, in the vicinity of Brookville, and from the northeastern part of the county, also from some caves in the neighborhood of Westport, Decatur County, where Mr. Edw. Hughes obtained several specimens, which are now in the collection of the Brookville Society of Natural History. It is possible that two specimens from Cincinnati, donated by Mr. J. N. B. Scarborough to the Smithsonian Institution (Nos. 8,818 and 8,841), and identified as *Spelerpes ruber* is this species, also that a specimen from Columbus, O., donated by the late Prof. L. Lesquereaux, (No. 3,872) should be referred to this form.

The only other species of *Gyrinophilus* is *G. porphyriticus*, Green. It seems to range throughout the Allegheny Mountain region. Its nearest approach to us is Columbus, Ohio, where Prof. Lesquereaux obtained a specimen.

Since writing the above I find, in the American Naturalist for December, 1891, pp. 1133–1135, an article by Prof. O. P. Hay, entitled, "Note on *Gyrinophilus maculicaudus*, Cope," which, since it relates to the subject under consideration, I take the opportunity to insert here.

"In the year 1889, Mr. A. W. Butler, of Brookville, Indiana, presented to Prof. E. D. Cope some specimens of a tailed batrachian that had been taken near the town named, in Southeastern Indiana. They had been collected, I believe, by Mr. E. W. (R.) Quick, and had been suspected by both Mr. Butler and Mr. Quick to be an undescribed species related to

Spelerpes longicaudus, which they greatly resembled. Prof. Cope's practiced eye immediately perceived that they were not members of the species named, and the results of his examination of the specimens were published in the American Naturalist, Vol. XXIV., page 967. Prof. Cope named the species *Gyrinophilus-maculicaudus*, assigning it to this genus because he found the premaxillaries distinct, instead of being anchylosed, as they are in *Spelerpes*. The species is otherwise distinguished from *Spelerpes longicaudus* by having a broader, flatter head; differently disposed vomerine teeth; by a ground color of vermilion; and by a different arrangement of the black spots. The limbs are also longer than those of *S. longicaudus*. I have had opportunities to examine several specimens, both living and alcoholic, of this beautiful species. Some of these have come to me from Brookville, through the kindness of Messrs. Butler and Quick. Two others had been taken in the vicinity of Bloomington, Indiana, by Prof. B. W. Evermann, of the State Normal School. After making a careful examination of the premaxillaries of several specimens of *maculicaudus* and comparing them with those of *longicaudus*, I am compelled to differ from Prof. Cope as to the generic position of this animal. In the case of all the specimens that I have dissected, except one, I find the premaxillaries to be consolidated. I have taken the premaxillaries out, dried them, and examined them with a sufficiently high power of the compound microscope, without perceiving any evidences of a suture between them. I can see but slight differences between the premaxillaries of it and *S. longicaudus*. In *Gyrinophilus* the premaxillaries are easily separated. In the case of the exceptional specimen mentioned above, the premaxillaries had been broken by accident just a little to one side of the middle line. Had the fracture been exactly in the middle line, I should have concluded that in this specimen the two bones had not united. This suggests that possibly an accident had happened to the specimen examined by Prof. Cope. If, however, Prof Cope's specimen really had the premaxillaries distinct, while in mine they are anchylosed, the genus *Gyrinophilus* can not stand. In any case, the species will, according to my view, have to bear the name *Spelerpes maculicaudus*.

"This animal is regarded by those who have observed it in its native haunts to be more aquatic in its habits than is *S.*

longicaudus. (On the contrary, it is perhaps less aquatic than *Spelerpes longicaudus,*—A. W. B.) The ones that I kept for some time in a small aquarium showed a disposition to remain out of the water. They would often climb up on the perpendicular glass wall of the aquarium above the water, and rest there for a long time. If, when thus adhering to the glass, this was turned in a horizontal position, they would continue to stick to the under side of it. I was not successful in my endeavors to get them to eat while in confinement. They appear to endure imprisonment well.

"During the Summer of the present year my son, W. P. Hay, secured two additional specimens of this cave salamander in the region about Bloomington. One of these was taken in May's Cave, about five miles south of Bloomington and a mile west of Clear Creek Station. It was found sticking to the wall of the cave, about four feet above the water and about one hundred yards from the cave's mouth. The other was captured in Kern's Cave, one mile southwest of Bedford, in Lawrence County. This locality is twenty miles south of May's Cave, and both are about a hundred miles west of Brookville, the original place of the discovery of the species. This shows that the animal is pretty well distributed throughout the southern portion of Indiana, and will probably occur also in the caverns of Kentucky. The specimen taken in Kern's Cave was also found clinging to the wall above the water, and at a distance of about a quarter of a mile from the entrance. Neither of the specimens made any effort to escape capture. Attention was attracted to both by the gleaming of their eyes in the candle-light."

Genus DESMOGNATHUS, Baird.

9. *Desmognathus fusca*, Raf. Brown Triton. A common species in the more broken parts of Franklin County, about springs and creeks. Doubtless found throughout the White Water Valley. It is also said to be common in Monroe County. The Monroe County form was wrongly identified in a previous paper (Journ. Cin. Soc. Nat. Hist., January, 1887, p. 265). *D. fusca* has also been taken by Prof. W. P. Shannon in Decatur County. The form *D. fusca auriculata* Holb. has been taken near Cincinnati, and is represented in

the Smithsonian Institution by ten specimens (No. 8,819) collected by Mr. J. N. B. Scarborough.

SALIENTIA.—THE TAILLESS BATRACHIANS.

GENUS CHOROPHILUS, BAIRD.

10. *Chorophilus triseriatus*, Wied. STRIPED TREE FROG; TREE FROG; PEEPER. Rather common in Franklin County, where discovered by Mr. Edw. Hughes, March 16, 1889, on which day he took three specimens. They frequent the ditches and sloughs of our uplands, rarely being found in our river valleys.

GENUS HYLA, LAURENTI.

11. *Hyla pickeringii*, Storer. PICKERING'S HYLA; PICKERING'S TREE TOAD. Common in Franklin County. Mr. Hughes found it very numerous on the uplands, where they frequent the ditches, sloughs and roadside ponds. Not so common in the valleys.

12. *Hyla squirella*, Bosc. SQUIRREL TREE TOAD; SQUIRREL HYLA. Two specimens of a peculiar frog from Franklin County, were sent to Prof. Cope for examination in 1887. He wrote upon receiving them that he thought the specimens were this species, but requested the privilege of examining them more carefully at his leisure. After doing so he wrote me, saying: "I have examined the little green frog of the first lot more fully and find it to be *Hyla squirella*, of darker color than usual, and with pale lateral line behind the angle of the mouth absent." One specimen was retained by him and the other returned. In some way my specimen disappeared, and no specimens of this species have since been taken. This is the only locality in the State from which the species has been reported.

REPTILIA—THE REPTILES.

OPHIDIA—THE SERPENTS.

GENUS EUTÆNIA, B. & G.

13. *Eutænia sirtalis graminea*, Cope. GRASS SNAKE; GRASS GARTER SNAKE. A new subspecies described by Prof. E. D. Cope, from a specimen in the collection of

Purdue University, No. 295, Richmond, Ind., (Proc. U. S. Nat. Mus., 1888, p. 399). The author says: "This form is a uniform light green above, below yellow, clouded with green. Lips, chin and throat uniform yellow. No stripes or spots on the body, nor markings of any kind on the head. Scales, 19 rows; superior labials, 7; temporals, 1–3, first large; gastrosteges, 150; anal, 1; urosteges, 66 pair, four of the latter undivided; lowest row of scales smooth; length, 495 mm.; tail, 107."

"This form is the extreme in the direction taken by the *E. S. ordinata*, where the bands are entirely wanting, but the quadrate lateral spots remain. In the entire absence of black marks on the labial and abdominal plates, this form differs also from its immediate allies."

14. *Eutænia butleri*, Cope. BUTLER'S GARTER SNAKE. A garter snake in the Purdue University collection, No. 264, from Richmond, Ind., was sent to Prof. Cope for examination. He determined it to be a new species, and described it under this name. (Proc. U. S. Nat. Mus., 1888, p. 399–400.) Of it Prof. Cope says: "Scales in nineteen longitudinal rows, the inferior much the widest and keeled. Superior labials, seven. Temporals, 1–1; the second large extending from parietal to labials. Oculars, 1–3. Parietals with the external border abruptly contracted. Gastrosteges, 144; anal, 1; urosteges, 62. Head very little distinct, muzzle conical, a little protuberant; eye not large. Ground color, above olive-brown, which is marked by the usual three longitudinal yellowish bands. The median covers one and two half rows of scales, and the lateral covers the second, third and fourth rows. Both are black bordered on both edges, the border of the latter band interrupted. The segments of the superior border of the lateral band represent the inferior spots of the lateral series; the superior row is wanting from the scales. Gastrosteges and urosteges olive, yellowish in front, dark behind, with a vertical black spot at the anterior border of each end of each of the gastrosteges. Labial scuta without black borders; head olive above without markings, except two small, yellow, black-edged parietal spots in the usual position.

"There is but one specimen of the species (No. 264), which is labelled as coming :rom Richmond, Ind. It is remarkably distinct from everything which occurs in the United States,

and has only superficial resemblances to the *E. flavilabris*, Cope, of Mexico. Its peculiar characters are the great width of the lateral color band, which covers three rows of scales, one more than in any other species; the black borders of the bands; the absence of well-defined dorsal lateral spots, and the absence of markings on the head and labial scuta. Besides these color marks, the presence of a large second temporal plate extending to the labials is peculiar to this species if found constant; and the narrow conical head is characteristic. In the *E. flavilabris* the general appearance is somewhat similar, but the labial plates are broadly black edged, and the lateral band covers but two rows of scales; there is a large postoral yellow dark-edged crescent, and the second temporal plate is smaller, and does not reach the labials.

"It gives me much pleasure to dedicate this handsome species to Mr. Butler, whose interest and labor in the natural sciences have resulted in many interesting discoveries."

15. *Eutænia radix melanotænia*, Cope. BLACK-SPOTTED GARTER SNAKE. Two specimens were in the Purdue University collection (Nos. 90 and 312). They were sent to Prof. Cope with the others just mentioned, and were considered to be a new form, and described as this species. (Proc. U. S. Nat. Mus., 1888, pp. 400–401). The following is the description: "Scales in twenty-one longitudinal rows, the inferior largest and keeled. Superior labials, 7 (8); frontal wide, oculars, 1–3. Parietals long, borders regular. Temporals, 1–2, the second above, moderate. Gastrosteges, 153; anal, 1; urosteges, 68. Head distinct; muzzle short, not protuberant. Lateral stripe on third and fourth rows of scales, not black bordered above or below. Dorsal band on one and two half rows of scales nearly completely black bordered. Between these the dorsal ground color is dark olive-brown, but the space is nearly occupied with the two rows of quadrate black spots. Below the lateral stripe two rows of alternating black spots, one on each row of scales, which sometimes coincide, on an olive-brown ground. Gastrosteges with a black longitudinal spot near the end of each, which is frequently confluent with the adjacent ones, from two to five running together to form an interrupted lateral central black stripe. Between these, the gastrosteges black edged, except on the anterior fourth of the length. Length, 285 mm.; tail, 65 mm.

Anterior dorsal region and top of head nearly black; two parietal spots. Labial plates and chin yellow, the former with broad, black posterior edges on the upper lip.

"In this species the scuta present no exceptional features, except that the frontal and prefrontal plates are more than usually wide, as compared with their length. In one specimen there are eight superior labials on one side, but this is probably an abnormality. Its twenty-one rows of scales separate it from the typical *Eutænia radix*, the species to which it has closest affinity, to say nothing of various peculiarities of coloration. It is nearest the subspecies *haydeni* of the *E. radix*, but differs from it in the interrupted lateral ventral black band and the black labial borders. It also approximates the *E. flavilabris*, but differs in a way opposite from the *E. butleri*. The dark colors predominate in the present species, and the lateral stripe of the gastrosteges is also peculiar to it. In the *E. flavilabris* there is also a large postoral yellow black-edged crescent, as in *E. marciana*, of which no trace appears in *E. r. melanotænia*."

Genus STORERIA, B. & G.

16. *Storeria dekayi* (Holbrook). DeKay's Snake. Vigo County, (Collection State Normal School, Prof. B. W. Evermann). Somewhat common in Miami County, (J. C. Cunningham). Monroe County, not common, (C. H. Bollman). Two specimens have been taken near Metamora, Franklin County, and these two are the only records from the White Water Valley.

Genus ELAPS, Schneider.

17. *Elaps fulvius* (L.). Bead Snake. Harlequin Snake. "Viper." A specimen of this snake, in the collection of Moore's Hill College, Moore's Hill, Ind., was taken in Ripley County (H. F. Bain). An account of this specimen was presented, by Prof. A. J. Bigney, to the Indiana Academy of Science, December 30, 1891. The only other evidence known to me, of the occurrence of this form so far north, is afforded by a specimen in the collection of the Cincinnati Society of Natural History, which was presented by my esteemed friend, the late Dr. John A. Warder. The record shows it to be from

Ohio. Dr. Warder's home was at North Bend, and possibly this specimen came from there.

GENUS SCELOPORUS, WEIGMANN.

18. *Sceloporus undulatus* (Daudin). BROWN SWIFT; COMMON LIZARD; PINE TREE LIZARD; ALLIGATOR LIZARD. Known to our country people by the names, "Fence Lizard," "Brown Lizard" and "Blue-throated Lizard." It appears to be common only in certain localities in the White Water Valley. In suitable localities in Franklin County it is very abundant. It has been taken in Jefferson County, near Madison, by Mr. G. C. Hubbard. Prof. O. P. Jenkins obtained a specimen on the banks of Fourteen Mile Creek, Clarke County, August 2c, 1887.

BROOKVILLE, IND., February 9, 1892.

REMARKS CONCERNING THE TEXAS WILD CAT LATELY PRESENTED TO THE SOCIETY.

BY S. S. SCOVILLE, M. D., LEBANON, O.*

(Read February 2, 1892.)

This cat was about eighteen months old at the time of its accidental death, in September, 1891. It was captured near Red River, in Wilbarger County, Texas, when but three or four weeks old, and presented to my little eleven-year old granddaughter, Bessie Owens, then residing with her parents in the above-named locality. It was fed on cow's milk, and at first would not lap, and had to receive its nourishment from a teaspoon. It was not long, however, until raw flesh became its exclusive diet. It never, up to the time of its death, could be induced to take the smallest particle of cooked meat of any kind. It was exceedingly fond of small birds, especially the English sparrow.

Upon the return of my son-in-law's family to Lebanon, they brought the cat and also a pet prairie wolf with them. These animals were then about four months old. Both were kept tied by means of a leather strap passed around the neck. Confinement was necessary, on account of their ungovernable propensity to nab up chickens. During the cat's life in Texas it was not confined, and was a constant associate of a common house cat, a setter dog and the above-mentioned prairie wolf

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LEBANON, O., January 25, 1892.

JAS. A. HENSHALL, Secretary C. S. N. H.:

Dear Sir — Mr. Raymond Smith informed me that some members of the Society would like to have something from me in relation to the Texas Wild Cat that was presented to the Society's museum through Mr. Dury. This desire, perhaps, arose from the fact that they had heard that the cat had been tamed (?).

I here enclose a short and hastily prepared paper regarding this cat, which, if you think interesting you can read to the Society. And possibly it might be worthy of publication in the JOURNAL. However, I will leave you to make such disposition of the paper as you see proper.

And permit me to say that it will please me very much if you will give the credit of the presentation of this animal to Miss Bessie Owens, instead of myself. It was her cat, and her attachment to it was wonderful.

Yours respectfully, S. S. SCOVILLE.

Occasionally the wild cat would steal off and prowl around the premises, but would soon return to join its companions. Almost from the time of its capture it became very playful, and was fond of being taken into the lap of some member of the family. Little Bessie was its special favorite, and from her it received the name of Joan, which, in one respect, was quite appropriate, for we know that the Maid of Orleans was an accomplished fighter. Upon its arrival at Lebanon, and up to the time of its death, it manifested this playful disposition. Nothing would please Joan better than to have a romp with children, or some animal that had the courage to approach within playing distance. But few dogs, however, would venture near her, and the domestic cat never. Her long sharp claws often imparted to her playful pranks an unpleasant sensation, and the person who courted lively sport with the cat, would often draw off, wishing that he had gone at it "with gloves." At the approach of night she would often seem lonesome, and was very fond of being brought into the house with the family. This was frequently done, to the great amusement of all present. After a general tear around the room, she would go for the house cat, frightening it nearly out of its wits. And next would be a rough and tumble play with the dog, one of her Texas companions. It was amusing to see how she would manage to spring upon the dog, which was more than twice her weight, and throw him sprawling upon the floor. The dog would often get mad and become furious, while the cat would show no real temper. It could be seen, however, by the little flying tufts of hair that the dog was being severely punished. The fracas would generally end by the dog drawing off for repairs. The cat was always disposed to continue the sport, and it was only by being taken upon the lap of some member of the family that it would quiet down.

Bessie would often carry Joan around in her arms, and occasionally lead her out upon the street, to the great delight—and sometimes fright—of the town children. She had a special fondness for the wolf, but this animal, though quite playful, kept very shy of her catship.

Judging from what I witnessed, respecting the disposition and habits of this particular cat, I am disposed to think that our opinions concerning the wild cat have been, in many re-

spects, quite erroneous. That it can be fairly well tamed, especially when taken young, there can be no question. It has a purr very similar to the domestic cat, but not nearly so loud in proportion to the size of the animal. It never spits and "gets its back up," as does the house cat. Its cry of hunger, of suffering, or for companionship, has no resemblance to the noises made by the last-named animal. Except when mad, it utters but one sound, which is not loud, and resembles somewhat the croak of a small frog. The growl, when mad, or when disturbed while taking its meal, is loud and frightful. It is a real tiger growl, having but little or no resemblance to that of the house cat. This cat, of which I have been speaking, was wakeful, and generally on the move during the day time. It slept, as a rule, during the night. Probably this is not the habit of the wild cat in its wild state.

In sending this animal to Mr. Dury for mounting, I called it the Texas wild cat, simply because it was captured in Texas. As to whether there is a cat entitled to this designation, I do not know. I know comparatively little about the wild cats of America. Many years ago I saw one that was captured in the west part of Marion County, Ohio, that was quite different, in several respects, from the one that has formed the subject of this paper.

NOTE.—This "Wild Cat," *Lynx rufus* (Raf. is the southern form of the animal. It has been mounted, and is now in the Society's collection.—CHARLES DURY.

ZOOLOGICAL NOTES.

BY CHARLES DURY.

WHAT I FOUND IN THE NEST OF A FIELD MOUSE.

It is well known to entomologists that some very curious and interesting insects live in the nests of mice and other small mammals. December 13, 1891, I went out to hunt nests of "field mice," in hopes of finding a very wonderful little beetle, called *Leptinus testaceus*, said to live in such nests. This species was especial desiderata with me, as I had never succeeded in finding it. I went to an old orchard, and under the first log rolled over I discovered a nest and secured a mouse as she rushed out. She proved to be the "Short-Tailed Meadow Shrew" *Blarina brevicauda* (Say). The nest was made of small bits of leaves of the "Sycamore tree," lined with grass fibers, and situated in a hole or pocket excavated in the ground. I lifted the nest into the sifting net and sifted it over a sheet of white paper, and was overwhelmed at the result. The fine debris was a jumping, crawling mass of insect life, beetles, fleas, ticks and larvæ. I gathered and bottled 107 *Leptinus*, and many ran over the edge of the paper and escaped. There were over a hundred large vicious-looking fleas, most energetic biters (as I discovered from those that secured a lodgment in my clothing). How the mouse could live in such a den is a mystery. The other beetles associated with Leptinus were *Staphylinidæ*, or "rove beetles" of species new to me, and so far I have been unable to identify them. *Leptinus* is a small, flat beetle, of a pale testaceus color, one-eighth inch long, without any trace of eyes.

AVONDALE, February 2, 1892.

OCCURRENCE OF THE "PIGEON HAWK," *Falco Columbarius*, IN CINCINNATI.

A male and female of this hawk were shot on the grounds of the Marine Hospital, Third and Kilgour Streets, December 16, 1891. A "screech owl," *Scops Asio*, was also killed at the

same time. They had been feeding on the sparrows that congregate there in great numbers.

DEATH OF OLD "ABE," THE MALE GIRAFFE AT THE ZOO.

The magnificent male "Giraffe" (*Camelopardalis Giraffe*) died at the Zoo, January 20, 1892. He was the finest specimen of his kind in captivity, stood over 16 feet high. The disease was tuberculosis of the lungs. His elongated cervical vertebræ and leg bones are quite remarkable. Both skin and skeleton have been preserved.

EXPLANATION OF PLATE V.

Fig. 1.—Bovistella Ohiensis, Ellis & Morgan. A specimen, natural size.

Fig. 2.—Diagrammatic section of *B. Ohiensis*, showing the cellulose and definitely limited subgleba and the free threads of the capillitium.

Fig. 3.—Thread and spores much magnified.

Figs. 4, 5, 6, 7.—Catastoma circumscissum, B. & C. Specimens nattural size, showing how it grows in the ground, finally breaks away and turns over.

Fig. 8.—Pieces of the threads and the spores much magnified.

Fig. 9.—Diagrammatic section, showing the origin of the threads of the capillitium.

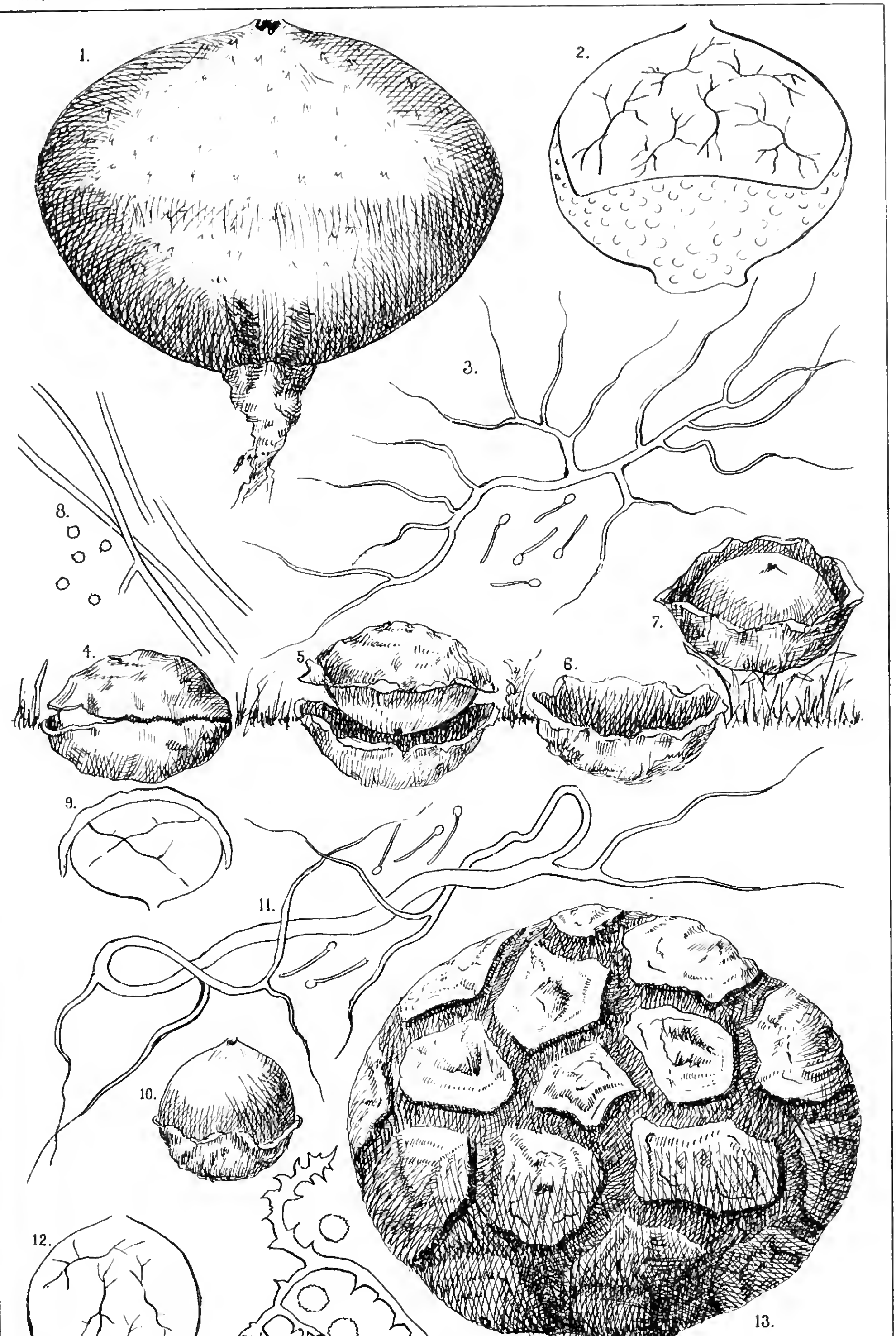
Fig. 10.—Bovista minor, Morg. n. sp.

Fig. 11.—Its spores and one thread much magnified.

Fig. 12.—Diagrammatic section of Bovista, illustrating the free threads of the capillitium.

Fig. 13.—Mycenastrum spinulosum, Peck.

Fig. 14.—Threads and spores much magnified.



Laura V. Morgan Del.

The Henderson Achert Krebs Lith. Co. Cincinnati

EXPLANATION OF PLATE VI.

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Fig. 1, side view, natural size.

Goniatites sciotoensis, n. sp.,	165

Fig. 2, side view, natural size.
Fig. 3, dorsal view with anterior end turned downward, and showing radiating furrows curving backward over the dorsum.

Trematoceras ohioense, n. sp.,	168

Fig. 4, lateral view, natural size.
Fig. 5, dorsal view, looking forward.

Goniatites occidentalis, n. sp.,	166

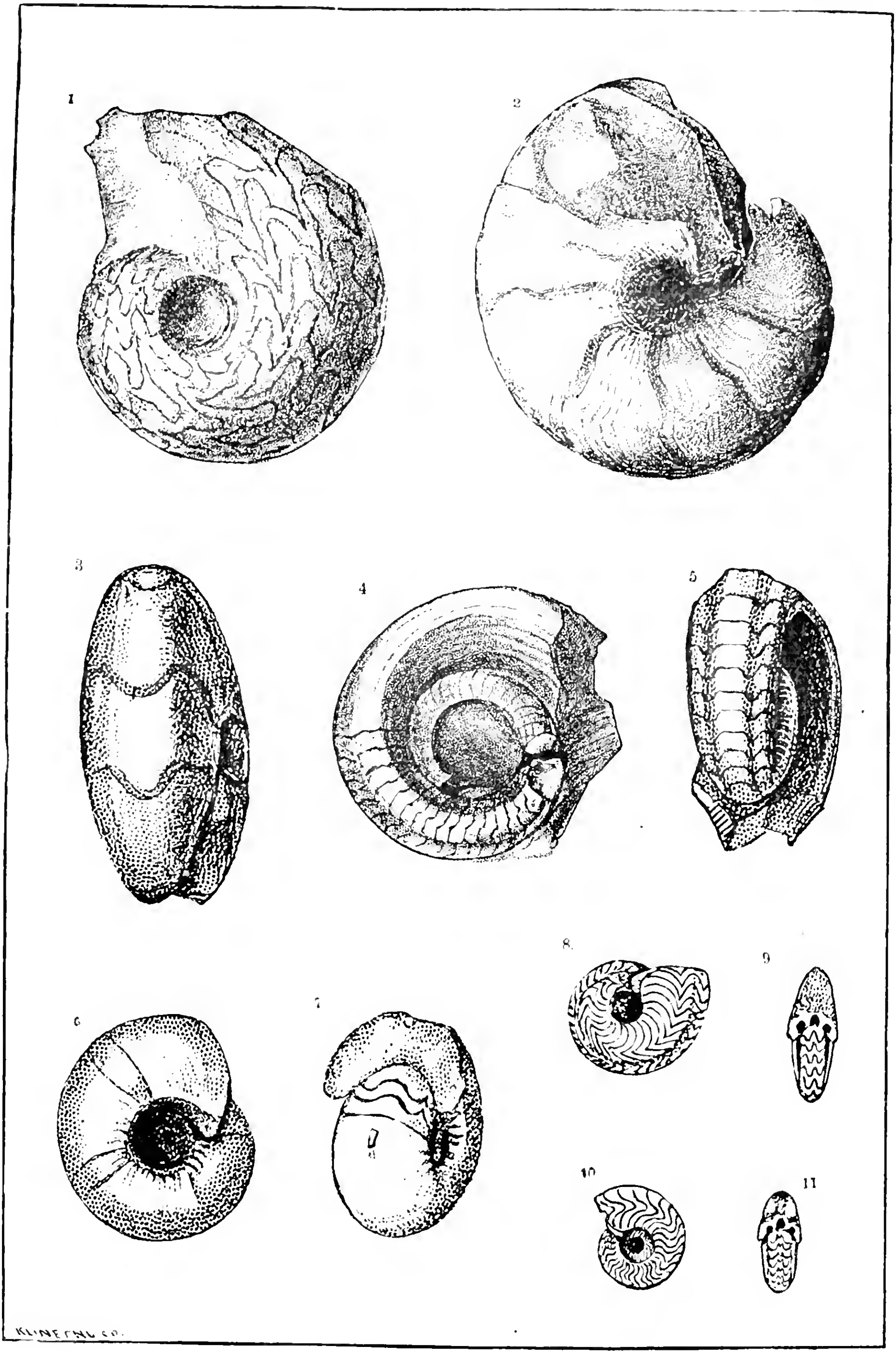
Fig. 6, lateral view, natural size.
Fig. 7, dorsal view, showing end of siphuncle at the upper margin and two spots where it is broken into on the dorsum, a radiating furrow and the outlines of two septa crossing the dorsum.

Goniatites limatus, n. sp.,	166

Fig. 8, lateral view, natural size.
Fig. 9, dorsal view, the fracture at the end destroys the saddles and lobes, leaving only the three inferior indentations.

Goniatites leviculus, n. sp.,	167

Fig. 10, lateral view, natural size.
Fig. 11, dorsal view, showing the septa on the dorsum and an end view.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OF THE

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VOL. XV.

THE JOURNAL

- OF THE -

Cincinnati Society of Natural History.

VOL. XV. · CINCINNATI, APRIL, 1892 · NO. 1.

PROCEEDINGS.

REGULAR MEETING, January 5, 1892.

J. Ralston Skinner, President *pro tem.*

Minutes of last regular meeting read and approved.

The following named persons were proposed for active membership: J. L. Cleveland, E. H. Crowell, John B. Mitchel, E. Hazard Wells, Dr. J. E. Baker and Geo. M. D. Morris.

As these names had been proposed for several months, but were not acted upon for want of a quorum at previous meetings, the Secretary, Dr. Henshall, moved that the rule regulating the proposal of members be suspended, and the candidates for this evening voted upon, which motion prevailed.

The following gentlemen were then unanimously elected to active membership: J. L. Cleveland, E. H. Crowell, John B. Mitchell, E. H. Wells, Dr. J. E. Baker and Geo. M. D. Morris.

The minutes of the Executive Board were then read for the meetings from June to December, 1891.

The resignations of Miss Amelia Merrell, Chas. J. Herrick, J. C. Wright, E. L. Anderson, Larz Anderson and E. W. Hobart were read, and upon motion accepted.

The resignation of Wm. H. Knight, as Librarian and member of the Executive Board, was read, and upon motion, accepted.

The Society then went into an election for a member of the Executive Board, to fill the vacancy made by the resignation of Wm. H. Knight.

Mr. F. A. Autenheimer and Dr. O. D. Norton were nominated, and balloted for with the following result: Dr. Norton received nine votes and Mr. Autenheimer eight votes, whereupon Dr. Norton was declared elected.

Mr. Chas. L. Faber read a paper, entitled, "The Age of the Point Pleasant Beds," upon the conclusion of which the paper was discussed by Mr. Faber, Mr. E. O. Ulrich and Mr. J. Ralston Skinner, and the paper was referred to the publishing committee.

Dr. O. D. Norton made some allusion to the deep well now being bored at Wheeling, and to a large specimen of quartz, containing silver, which would probably be donated to the Society next Spring.

The death of Mr. Wm. Gibson, a life-member, was announced.

Adjourned.

REGULAR MEETING, February 2, 1892.

President Abert in the chair.

Mr. T. B. Collier elected Secretary *pro tem.*

The minutes of last meeting were read and approved.

The resignation of Mr. Alex. Starbuck, as member of the Executive Board, was read, and upon motion, action on the same was indefinitely postponed.

Mr. D. L. James read by title a paper by Mr. A. P. Morgan, on North American Fungi, and a paper on the Paleontology of the Cincinnati Group, part two, by Joseph F. James.

Mr. James also read a very interesting letter from Dr. Scoville, of Lebanon, Ohio, in relation to the history of a wild cat, now in the museum of the Society.

Adjourned.

DONATIONS, JANUARY TO MARCH, INCLUSIVE.

Ed. C. Pickering: Chronological History of Plants.

Joseph F. James: Studies in Problematic Organisms (pamphlet).

S. A. Miller: Sixteenth Report State Geologist of Indiana (two copies).

In Memoriam.

Dr. Andrew Jackson Howe was born in Paxton, Mass., April 14, 1826, being of the fourth generation of his family, whose birth place was here. His great-great-grandfather came to Paxton from Marlboro in 1743, and thence he traced his ancestry to the baronial family in England.

After attending the public school, he fitted for college at Leicester Academy, and entered Harvard University in 1849, graduating in the class of 1853.

He studied medicine in the Worcester Medical College, and at the Jefferson Medical Institute, Philadelphia, and attended lectures and visited the hospitals of New York City. The first practice of his profession was in Lowell, where he took care of Dr. Burnham's surgical practice six months while the latter was in the State Senate. Dr. Howe then opened an office in Worcester, and was installed into the Chair of Anatomy in his alma mater, leaving it to take a similar position in the Cincinnati College of Medicine, which held its sessions in the Mercantile Library Building.

This determined his removal to Cincinnati. He was married in 1858 to Georgiana Lakin, who still survives him. In 1863 he was called to the Chair of Anatomy in the Eclectic Medical Institute, and from this, in 1871, was transferred to the Chair of Surgery, which he occupied at the time of his death. He was the author of the following works, namely: "The Art and Practice of Surgery," "A Treatise of Fractures and Dislocations," and "Operative Gynæcology." He was a stated contributor and assistant editor of the *Eclectic Medical Journal*, and wrote a number of papers for other magazines. Dr. Howe secured many valuable specimens for the collection of this Society. Among them were some skeletons of the curious mammals of New Zealand, which he obtained through his correspondence with that distant island. He was an indefatigable and tireless worker, widely known as a skillful surgeon with a large practice, yet he always had a keen interest in zoological studies. A man of such strong physique to go so soon, taken before his work was done. To him the beautiful lines of Bryant's "Hymn to Death" fitly apply:

"Oh, cut off
Untimely! when thy reason in its strength
Ripened by years of toil and studious search,
And watch of nature's silent lessons, taught
Thy hand to practice best the lenient art
To which thou gavest thy laborious days,
And last, thy life. And therefore, when the earth
Received thee, tears were in unyielding eyes
And on hard cheeks, and they who deemed thy skill
Delayed their death-hour shuddered and turned pale
When thou wert gone."

CHARLES DURY,
GEO. W. HARPER,
DAVIS L. JAMES,
Committee.

WEATHER, WATER AND DISEASE.*

By Dr. Wm. Carson.

Our morning salutations to our friends and neighbors, pertaining to the weather, are not things of social significance only. They serve an admirable purpose, as a sort of introduction to the more serious business of the day, and are not intended to be analytical or profound. They imply, however, an outside world, a relation of it to the individual, experiential and dependent as to the latter—in the imperial presence of nature's law.

The individual comes into his environment, with adjustments of structure and function, prepared by many successive generations. He dies after leaving to his descendents the essential features of his constitution—but the eternal forces of nature survive him—to demonstrate in an impressive way the perpetuity of the environment and the transient existence of the individual. It is from this point of view—the mutual relations between the individual and weather, water and disease—that we propose to speak this evening. In the progress of science, or knowledge in general, there are two methods by which results are accomplished—first, that of observation; second, that of experiment. Centuries may elapse between the observation of a phenomenon, or fact, and its experimental or scientific proof or explanation, so that we may paraphrase a sentence and say that in the vastness of science "One day is as a thousand years and a thousand years as one day." Various causes have proved obstructive. The survival and spread of myths have curiously shaded the bright light of correct observation. The tenacity of theological dogmas has interposed effectual barriers, against which scientific methods have slowly prevailed.

Hippocrates, the Father of Medicine so-called, wrote thus more than 2000 years ago: "Whoever desires to understand

*A lecture delivered in the Free Lecture Course of the Society, March 3, 1892.

medicine thoroughly can by no means neglect the subject I am about to consider. The different seasons of the year, and what each is capable of affecting, will prove a source of reflection to him. They differ altogether from each other. Diversity exists in their respective constitutions, and even in their individual variations. We study the winds both as to heat and cold. Those that are common to all countries; and those that are peculiar to certain regions. We ought also to examine the properties of the waters, since all are not alike in taste, or gravity, so neither are they in virtues. Whosoever, therefore, arrives at a town, of which he is not an inhabitant, should begin by regarding its position in relation to the winds and the rising of the sun; he will not consider it as a matter of indifference, whether its exposure is to the north, the south, the east or the west; on the contrary, he must have a strict regard to its position and to the nature of its waters; he must examine whether they are muddy, hard or soft; if they pass through high and stony places; if of a saline nature; and if they sit light on the stomach, and are well adapted for cooking vegetables. He should inspect the soil; and notice whether it be naked and arid, or covered and moist; if sunken and sultry, or high and airy. * * * * Should it be objected that the information which I thus require appertain to meteorology, I reply, that a knowledge of the situation of the heavenly bodies is not one of the parts least essential to form the physician; on the contrary, it is highly useful. The succession of the seasons is accompanied with remarkable changes in all the cavities of the body." We have here an outline, simply expressed, of the knowledge necessary for a physician to have in relations to weather, water and disease. It embodies the observation of the time and comes down to us with its guarantee for the usefulness of its inculcations. It is observation and not experiment.

Weather is a product of many complex units. It has its cosmic or world-wide elements, and its telluric or local ones, each of different potentialities. Among the local ones, we may mention the topographic features of land and water and vegetation, which exercise a limited influence compared with those which have principally their origin from the sun.

The principal factors of weather are atmosphere, with its

natural and invariable constituents—oxygen and nitrogen—in certain proportions, and its accidental and variable ones. Important among these is the weight of air, light, temperature, humidity and winds. We shall endeavor to assess the value of each of these units in its relation to its effect upon the individual. Practically, there is no such actuality as their acting as units, complete disassociation can not occur, nor can they act in entire combination at any one period of time, because, in the first supposition, there can be no severence of relations established by a common derivation; and in the second case the change of the earth's position in its movements around the sun compels succession of results and not simultaneity. It can not blow hot and cold at the same time.

Probably there is no more complete correspondence than that which has been brought about, in process of evolution, between the structure and function of the lungs— in the absolute necessity of the inhalation of oxygen and the exhalation of carbonic-acid gas and moisture. Respiration must be carried on, and there is not left to the individual ability to modify it in any way except by violent and destructive means. He can not commit suicide by simply holding his breath, nor is there any hibernation for the human animal. A certain rate of respiratory movement is foreordained. The movement is about eighteen to the minute in the adult human being in quietude or ordinary motion. This will be modified by bodily effort, a nervous excitement, rarefied air, or high altitudes, or disease. Provision is made for a return to the normal rate on cessation of the exciting cause. There is a very wide variation in the animal kingdom in the number of respirations per minute, running from one in the hippopotamous to one hundred in the rat while sleeping and two hundred waking.

The red blood corpuscles are moving in rotation, carrying their precious load of oxygen to all parts of the body, and the lungs are exhaling the excretory product carbonic acid, with a certain amount of moisture. While we have spoken of the stability of the mechanism of respiration, the human being has a limited amount of power to alter the composition of the atmosphere in his immediate surroundings. There is much perversity in the ways by which we exclude the fundamental

element of our being, the oxygen of the external air, from our houses, and substitute its toxic element, carbonic-acid gas, thus neutralizing to some extent the vital necessities of our existence. It is scarcely too much exaggeration to say that the worst outside air is better than the best inside air. If the results are not rapidly explosive in appearance they are certainly devitalizing in results. Altitude may diminish the absolute or relative amount of oxygen in mountain resorts, but there is compensation in the increased amount of respiratory movements, and in the otherwise greater purity of air.

Any obstruction to the entrance of the proper amount of oxygen into the lungs is liable to modify the whole series of nutritive processes going on in the tissues of the body. Correlated with oxygen we mention ozone—as found in the air. It has been supposed to be a form or derivative from oxygen. It is an active oxidizing agent, and a purifier of the atmosphere. It is found in larger quantities outside than inside of cities. It exists in considerable proportion in evergreen forests, and much good has been ascribed to it in the "Wood's life" of the consumptive. There is, however, much difference of opinion as to its true constitution and import, and it has not been available practically.

LIGHT.

Of light, in its relations to health, we can say naught, except of its beneficences. It has not such direct vital relations with the human system as the atmosphere; it is not so demonstrably necessary as it is—yet there is no doubt of its importance in the molecular changes going on at the surface of the body. Mrs. Browning has given a poetical expression of this, when she speaks of "taking the winds into our pulses and mixing sunshine with our blood." Light is more pervasive in its distribution than oxygen, but necessarily, on account of the alteration of night and day, is not continuous in action. Its necessity in promoting vegetable growth is common knowledge. Such a reversal as takes place in the atmosphere during the night in regard to the quantity of carbonic acid and oxygen is sufficient evidence of the importance of light to the vegetable world. This is produced

by the combined action of the luminous, calorific and chemical rays of the sun, and is not, therefore, exclusively due to the chemical ones. Neither is growth always suspended during the night, for it is stated that some plants accumulate reserve material, which enables them to continue growth in some of their parts that begin in daylight. Add to this statement all of the instances of the known effect of the chemical rays of light in producing chemical combinations of an inorganic kind, and the instances of disassociations of compounds, sometimes with explosive force, and we may well be convinced that such a power will not stop short of the vegetable kingdom. It will exercise some of its force, at least, in the molecular action going on at the exposed surfaces of the human body. The changes in the pigment matter are an instance of it. The withdrawal of the rays of the sun is indirectly instrumental in modifying other elements of our environment, as the humidity and temperature of air and soil. The damp, cool air of the night, the heavy deposition of moisture from a warm air, on the cooler ground, or the rapid radiation from the soil, which takes place into a dry air, will not unfrequently furnish conditions sufficient to disturb the equilibrium of health in an unstable constitution. The latter combination is what brings about largely the extreme variations found in mountain climates between mid-day and mid-night, and against which unhealthy persons must carefully guard themselves.

The depressing effect of long-continued cloudy weather is to be mentioned. Few escape it entirely. The contrasted effect of succeeding sunshine is one of our delightful experiences, and operating through our nervous system influences favorably our bodily condition.

These statements are proof of what we said of the beneficence of this element of our surroundings; we do not accept our opportunities. We perversely shut out the light from our houses, and in doing so often corrupt the air within them. We bleach our faces and those of our children, instead of sun-painting them. It is said darkness is dirt, and dirt is disease, or at least its nesting place. In proof of this we may mention the effect of light on various kinds of microbes. It has been investigated experimentally by English, French and

German bacteriologists, with the following results: That the light retards or prevents their development whenever the experiment is tried in the presence of air, and that the retarding effect is owing to diffuse light, and above all to the actinic rays of the solar spectrum (Arloing, Les Vivus, p. 93). The action is nearly independent of temperature. Typhoid bacilli are affected by light injuriously, so that there will be a difference of two days in growth between those exposed to light and those protected from it.

In the calorific rays of the sun we have another essential factor of weather, that of temperature. Unlike the quiet action of the luminous and chemical rays, we have in heat the great motive power of weather. Chemical rays have a limited power of originating motion in the plants. Sach's "Text Book of Botany," p. 738, says: "Chemical action, so far as they are in the main dependent on light, are produced chiefly by rays of medium or low refrangibility, (viz: the red, orange, yellow, or green). This is the case, for instance, in the production of the green color of chlorophyll, the decomposition of carbon dioxide and the formation in chlorophyll of starch or sugar. On the other hand, the rays of high refrangibility (the blue or violet, as well as the invisible ultra-violet rays,) are the principal, or the only ones, which produce mechanical changes, so far as these are dependent on light. It is these rays which influence the rapidity of growth, alter the movements of the protoplasm, compel swarm-spores to adopt a definite direction in their motion, and change the tension of the tissues of the motile organs of many leaves, and hence affect their position."

Compare these limited motions within the plant entirely, with those originating in differences of temperature and humidity, such as the lightest breeze can produce, and the contrast is striking. Temperature is, therefore, much more potential than mere light, and has greater bearings on the human being, as a unit of weather. The same rays of light that travel from the sun through space, with a temperature —200°, are differentiated when they reach our atmosphere and the earth, some acting with silent equable force on the vegetable world and others developing the prodigious energy of our storms; some originate molecular and others cyclonic

motions. Here begins a prominent characteristic of our weather—its variability. We all take the privilege of commenting on it and condemning it, forgetting that the average temperature of a series of years does not vary much. The law of correlation of forces ensures that. Strict uniformity of temperature, whether low, medium or high, is not desirable in a health point of view. The simple fact, that such a thing does not exist, is proof of it. A man or woman without some reactionary power toward the infinite diversity of human life, is enervated and insipid. The weather, without some insurrectionary power, deprives you of much healthy stimulus to all your functions. In a mixed population, composed of great varieties of constitutions, temperaments and acquired weaknesses, all will not respond to external stimuli with safe and equal resistance. Action and reaction are not always equal in physiology or pathology as in physics. The capacity to endure heat and cold is no doubt part of the hereditary or acquired power of each individual. Some endure cold better than heat or heat better than cold, so that, in the actual conditions of life, it can not be said that severe changes never do harm. Physicians recognize these constitutional susceptibilities, and always advise against the chances of chill — a word we use as against the idea of mere cold. Simple reduction of temperature is not productive of disease — there must be some other element within the individual that has impaired his reactive powers. If he be healthy, he can over-ride degrees of cold that would be sure to destroy another with taint of constitution or accidental weaknesses. Like a vessel in a storm, with a competent commander, he will come out of it with whole timbers and renewed strength for the next emergency. A so-called cold (a phrase which has been used both by physicians and laity as explanatory of a great variety of diseases) is composed of two elements, a predisposing one and an exciting one — a pre-existing unhealthy state of the system and a relatively too great external impression from reduction or variation of temperature. The so-called bilious disturbance of the system is a common predisposing cause of serious so-called colds. Other conditions, capable of bringing about similar predisposing causes, will be noticed later.

Many severe tests of our constitutional strength come to us with our cyclones. On eastern margins of these storms, or near their centers, before rain begins, we often have quite a warm and oppressive atmosphere. Within varying, but short periods of time, extreme drops of temperature occur. What may result from one of these storms is illustrated by a statement from Mr. Wm. A. Eddy, in the "Cosmopolitan" of October, 1891. He says: "That in the great storm of Feb. 10, 1884, about 800 people were killed, 2,500 wounded, and the homeless and destitute numbered from 10,000 to 15,000." We can well imagine that much sickness must have followed it. This is part of the record of the greatest storm that ever visited the United States, and a special investigation of it was ordered by Congress. To what extremes of temperature we may be exposed can be shown by reference to Signal Service Reports as given by Lieut. Greely ("American Weather," p. 129, etc.): "The highest recorded readings have been 119° at Fort McDowell and Phoenin, Arizona, June 18, 1883; 118° at Fort Yuma, Arizona, July, 1878. From other observations are quoted temperatures of 128° at Mammoth Tank, Cal., July, 1887; 122° at Humbolt, Cal., July, 1887; 121° at Fort Miller, Cal., June, 1853; 120° at Fort McCrae, N. M., June, 1873; 119° at Fort Mojave, Arizona, August, 1875; June, 1876, and July, 1877.

The lowest Signal Service temperature was observed at Poplar River, Montana, January 7, 1885, —63.1°; Fort Assiniboine, —55.4° (February). Many others ranged between —47.5° —39.1°, which latter was at Pike's Peak.

What is of more importance, we have very great daily variations. Our resistance is tested by those more than by occasional extremes of heat and cold. Quoting Lieut. Greely again: "The highest daily range occurs as a rule, in the Summer months, from May to July, inclusive, except along the South Atlantic and Gulf Coasts. At Fort Apache, Arizona (elevation 5050 feet), the mean daily range for June is no less than 42.6°. These ranges are exceeded at Campo, Cal. (2,710 feet), where the mean range from June to October averages 44.8°. At Denver, Col., the greatest resort for consumptives, a fall of 60.4° took place—34.3° in eight hours. Yet consumptives, with proper precautions, do well there.

Many more illustrations can be given of equal rises of temperature in less than sixteen hours at Denver.

It will be realized from these figures that there is need for unusual powers of resistance at intervals at least.

How much a storm may include in its embrace at any one station in its progress, and how many individuals it may affect, can be realized from T. Russel's statement in "The Engineering Magazine," December, 1891, as to the "conditions of a cold wave." He says: "A cold wave is a fall in temperature of twenty degrees or more in twenty-four hours, free of diurnal range, and extending over an area of at least 50,000 square miles of country, the temperature somewhere in the area going at least as low as 36°." In one of the greatest cold waves in recent years, that of February 17, 1883, the temperature at 7 A. M. was twenty degrees lower than at the same hour on the day preceding throughout an area of 1,065,000 square miles, extending from Lake Superior and Georgian Bay on the north to the Rio Grande on the south, and from Kansas City to Cincinnati. Inside of the area of twenty degrees fall there was an area of thirty degree fall of 640,000 square miles; inside of the area of thirty degree fall there was an area of 187,000 square miles; inside of the forty degree fall there was 31,000 square miles of fifty degree fall, and inside of the fifty degree fall a fall of sixty degrees at Keokuk, Iowa, the center of the cold wave. In ten years there have been two cases with the falls at the center greater than sixty degrees; the greatest being sixty-three degrees at Moorehead, Minn. There have been sixteen cases with the greatest fall between fifty and sixty degrees; seventy-seven between forty and fifty degrees; 284 between thirty and forty degrees and 278 between twenty and thirty degrees." It is a fascinating story of the great upper ocean of the atmosphere. Add to it a calculation of the weight of this air moving in its fury over a million and more of square miles, and we need not wonder at the myths of old, which put "Vulcan forging thunder bolts, Jupiter hurling them at his enemies, and Eolus directing in the cave of the winds." Or the later conceptions of theological origin, which saw demons and witches riding or originating storms for sinister purposes.

Another component of weather is the atmospheric pressure—which, at sea-level, is nearly fifteen pounds to the square inch.

There are modifications of this, which have more or less relation to personal comfort or health. Altitude modifies it in some regularity of proportion to ascent above sea-level. The effect of sudden change from low to high levels has often been experienced and described by those who have made balloon ascents. These voyages, when undertaken for scientific purposes, have been to such extreme heights as to afford no basis proper for experiences that would be applicable to the residents of low levels, or even the ordinary high ones. The time consumed in the change is the very important condition of such experiments. As a consequence, there is no vigor of constitution or elasticity of adjustment of the organs of circulation and respiration that will prevent asphyxia or heart failure when the change is very rapid, or to very high levels. The late Paul Bert, an eminent member of the French Academy, has given us the most scientific treatise on barometric pressure, has investigated experimentally the results on animals and vegetables. He proved, by many experiments, that seeds and plants germinated and grew more slowly under diminished pressures, and endeavored to determine to what this was due, the rarified air as a physical condition or the diminished oxygen as a vital one. His conclusion is that the diminished amount of oxygen is the true cause. He says: "I am entirely authorized to draw, from all of the facts, the conclusion that, at low barometric pressures, an animal consumes, in a given time, a notably less quantity of oxygen and produces a notably less quantity of carbonic acid than at normal pressure," and farther, "that it remains proved that at low pressures the diminished activity of chemical phenomena bears not only upon those which result in the production of carbonic acid, but that the whole series of intra-organic oxidations is diminished when the air is sufficiently expanded."

Where change of altitude is made slowly and with as little fatigue as possible, tolerance becomes established without danger, and the acclimatizing process is facilitated. It is the uniform advice of physicians to patients going to high altitudes, not to go abruptly, but by easy stages.

The experiments of Paul Bert furnish the scientific justification of such advice. It often happens that in our weather

changes, the barometric pressure is suddenly lowered to what it would be at a much higher level, and that it, therefore, comes in as one element in the uncomfortable effects noticeable in a good many people during storms. The storm effect is the same in kind, if not in degree, as the altitude rarefaction and diminished oxygen brings about. There is an approximate standard of air pressure in every locality. If there be sudden and considerable change from it by the approach and movements of storm, it contributes its share to the healthy or unhealthy effect. As a prognostic, a sudden change means a sudden reaction. The capacity of living under extreme variations from sea level to 15,000 feet or more is demonstrated by well known facts, but Jourdanet, the French writer on climatology, after his own experience and observation at high levels in Mexico, where he lived, says that people living above 8,000 feet are not healthy.

HUMIDITY.

Where there are land and water, and an atmosphere coexisting, with the solar rays pouring their heat down upon them, there must be humidity or the vapor of water in that atmosphere. The direct genesis is from the water and heat. The land is a receptacle and reservoir for the precipitation of the vapor in the form of rain, and returns the vapor to the atmosphere in varying degrees and rates. The condition of a rapid return is that the radiant heat shall not be obstructed by bodies of visible vapor, by fogs, or clouds. The dryer the superimposed air the quicker the radiant heat passes into the space above, and the lower the temperature of the ground and layers of air immediately above become. The barometric pressure is greater and oxygen more abundant. If fog, mist or cloud overlie the ground, they absorb the radiant heat, and the earth and atmosphere are warmer. Rapid evaporation means cooler temperature and dryer air—hence, the great difference between sun and shade and liability to nocturnal chill. A cloud passing between the sun and a thermometer not suspended directly in the sun will sometimes produce an increase of heat in a few minutes, because of a diminution or suspension of radiant heat.* Tyndall's graphic statement as

*Tyndall, p. 428.

to absorption of radiant heat by vapor of water is worthy of reference: "Aqueous vapor is a blanket, more necessary to the vegetable life of England than clothing is to man. Remove for a single Summer night the aqueous vapor from the air, which overspreads this country, and you would assuredly destroy every plant capable of being destroyed by a freezing temperature. The aqueous vapor constitutes a local dam, by which the temperature at the earth's surface is deepened."

In the air, saturated, or nearly so, with moisture, you have less barometric pressure, less oxygen and a warmer temperature. All of us have experienced such weather. The excessive humidity invests us so that the natural transpiration through the skin and lungs is obstructed, the oxygen is diminished and retention of carbonic acid is increased, and we are enervated. The deposition of this excessive moisture, in the form of rain, is a great relief from the depression caused by the previously existing humidity, low pressure and calm. It cools and purifies the air by allowing more evaporation and bringing down the impurities of the air.

WIND.

Wind is air in motion, arising from differences of temperature and largely determined and directed by differences of barometric pressure between two places or regions more or less remote from each other. It promotes evaporation, and is cooling on the surface or individuals within its range. It tempers the heat of Summer and removes bodies of vapor that may be interfering with radiant heat. It removes, for the time being, the foreign or accidental products in the air. Its interconnections are with temperature and humidity principally. A cold, damp wind in Winter, such as we know our northeasters to be, is very trying to our feelings and vigor, and are the dangerous winds to the infirm or the aged, even. A warm wind is a pleasant change from a close, muggy, stifling and calm atmosphere. The south-west wind is the rain-bearing wind of our latitude; the south the warm one; the north and the north-west the cold and dry, or anti-cyclonic ones. We have thus imperfectly gone over some of the relations of the units of weather to the individual.

DUST AND FOG.

We come now to what may be called accidental features of our air. First, its dust and fog. Our present knowledge of it has been obtained by scientific and precise processes; we can literally count the floating dust of our atmosphere. Tyndall's electric light demonstrated its abundance and its presence everywhere. Aitkin has invented recently an instrument for counting the infinitely small atoms. We shall give the results of his investigations, and especially as they bear on our sanitary state (*Nature*, Nov. 5, 1891, p. 10, etc. Dr. W. J. Russel, at the Hygienic Congress). His basic principle is that a change of state, a gas passing to a liquid or a liquid to a solid, really always occurs at what he terms a "free surface;" that as long as a molecule of liquid water is surrounded by like molecules, and the same with gaseous water, we do not know at what temperature, or whether at any, they would change their state; but if in contact with a solid then at the surface, where they meet, the change will occur. The dust always in the atmosphere offers this free surface to the gaseous water, and thus induces its condensation. This specific action of dust varies very considerably. First, with regard to its composition, and second, with regard to the abundance and size of the particles present. Sulphur burnt in the air is a most active fog-producer, so is salt. Many hygroscopic bodies form nuclei having so great an affinity for water that they can cause its condensation from an unsaturated atmosphere. At the same some, non-hygroscopic bodies, such as magnesia, and many others, are powerful fog-producers.

The products of combustion, even when the combustion is perfect, are powerful fog-producers. He shows how exceedingly small an amount of matter is capable of inducing fog. One one-hundreath of a grain of iron wire, however, after it was heated, involved on each heating sufficient dust to cause a visible fog, then with still more delicate apparatus, that $\frac{1}{1000}$ of a grain of either copper or iron gave a similar result, and he infers that even $\frac{1}{100000}$ of a grain would yield sufficient nuclei to cause visible fog. This small amount of dust can be filtered out, and then no fog will occur. Mr. Aitken has invented an instrument, small enough to go into

his pocket, by which he can count the number of particles in the air at any place. He has counted 7,500,000 of dust particles in one cubic inch of the ordinary air of Glasgow; 4,000,000 in a cubic inch of air outside the Royal Society Rooms, Edinburg; inside the rooms, after the fellows had met for two hours, on a winter evening, the fire and gas having been burning, 6,500,000 in a cubic inch, four feet above the floor, but near the ceiling no fewer than 57,500,000 in the cubic inch; in one cubic inch of air right above a Bunsen burner 489,000,000 of dust particles. These fog deposits have also been weighed, so that in the Chelsea district of London it amounted to the rate of six tons to the square mile. Purely gaseous emanations can not pass away from a town while fog exists. Take four in 10,000 volumes of air as the normal proportion of carbonic acid, in case of a dense fog, it amounted to as much as 14.1, thus seriously contaminating the air while it lasts. The analysis of fog deposits at Chelsea showed:

Carbon	39.0
Hydrocarbon	12.3
Organic bases (pyridines)	2.0
Sulphuric acid	4.3
Hydrochloric acid	1.4
Ammonia	1.4
Metallic iron and magnetic ore iron	2.6
Mineral matter (chiefly) silica and ferric oxide	31.2
Water, not determined (say difference)	5.8.
	100.0

It is said of this deposit, "it was like a brown paint, it would not wash off with water, and could only be scraped off with a knife." The fog collected from Ancuba leaves at Manchester had six to nine per cent of sulphuric acid and five to seven per cent of hydrochloric acid. Three days of fog in Manchester deposited per square mile of surface one and a half per cent sulphuric acid.

Dr. Russel shows, from the Registrar General's report, that the fogs are followed by an increased death rate, mainly by reason of the fact that fogs are accompanied with falls of temperature. In one case, where there was a temperature above the average, the death rate was not increased. There is

no case of depression of temperature not followed by increase of death rate. Two English writers, in the February number of the "Contemporary Review," say: "The painful irritation to the eyes, the choking sensation in the chest, together with the general depression of the spirits and many other ailments, are the lesser sufferings that few who are exposed to it escape. But it is not yet realized what an amount of serious illness, or how many deaths one week of London fog causes. It may be accepted that every ten days of this terrible visitation kills 2,500 people, and if we calculate nine serious cases of illness to each death, we have near 25,000 laid upon beds of sickness."

On plant life the effect of town fogs is great. At Kew gardens and hot houses, plants inside of some cover were prevented from growth. "Bushels of healthy looking leaves were picked up almost every morning. There is also great absorption of light by fogs. The slower vibrating red rays can struggle through a fog which is absolutely impervious to the more refrangible ones. A mist but slightly tinged with smoke is opaque to the blue rays, but heat rays pass readily through." The shutting out of the blue rays cuts off the most active chemical ones. The number of sunshine hours counted at five stations, one in the heart of the city of London, and others not far from the city, were as follows: In November, December, January and February 95.8 in the city, at the others 150, 17, 17, 205.9 and 268.3. It will be seen that fog, as a factor in weather, may become injurious to health by interfering with the action of light, by the retention of excessive quantities of carbonic acid, which would otherwise escape, by the low temperature which accompanies it, and by the much reduced number of sunshine hours, and by encouragement of bacterial growths, or rather preventing the noxious effect of sunlight on those already in the air.

The next factor of air as an agent of disease is the bacterial. Here we enter a field where acute and accurate scientific methods have the most successful illustrations. The effect has been that the germ theory is almost common knowledge. For over 200 years it has been at times within the horizon of the human mind, going and coming like a planet, whose orbit had not been calculated. Many able and ingenious minds have been and are now working with wonderful enthusiasm

and industry on this subject. They have achieved results of not only high scientific interest, but of practical benefit. The history of its development and present status has very much of interest, and corresponds to that which has been known in the history of many other scientific subjects.

Progress has been slow, many obstructions and misconstructions have appeared, until now it has apparently solid foundation, though it is evident much remains to be done.

On this theory the germs are of vegetable origin. They are exceedingly minute, being much smaller than the white corpuscles of human blood—amazingly abundant in and out of the human system—pervade air and water and the soil, and grow with great rapidity. They have their anatomy, which is of the simplest, such as that of protoplasm; they have their physiology, chemistry and biological characteristics, that have been elaborately studied and determined, and they have enormous reproductive power. Their shapes are varied; some are rounded; some rod-shaped and others are spiral. They are called respectively micrococci, bacilli and spirilli. The rounded are the simplest forms of about $\frac{1}{25000}$ of an inch in diameter. Some live without oxygen and others must have it. The number of bacteria in the air is large; greater in Summer than in Winter; greater at low levels than on mountains, in the cities than out of them, in the dark than in the exposed places. Their number diminishes after a rain. They live at varying temperatures.

There are two main divisions, so far as their modes of living are concerned; one called Saprophytes, who live on dead matter—animal or vegetable. They resolve it into carbonic acid and ammonia, which serve as foods for the vegetable world. They are not hurtful to the living human body.

The other division is called Parasites, and they obtain their foods from human or vegetable matter. The products of their life processes are noxious to the living matter, and in this way this class becomes the source of many diseases.

Instances of benefits from bacteria are known in two important relations—they intervene in the process of digestion and promote it. They form the "tertium quid" between the structure of the stomach and its ultimate function—digestion. The entire digestive tract is a productive "habitat" for

microbes. Another important function is, that they prepare soils for vegetable life. A soil that is sterilized or deprived of all its microbes will not afford the proper nourishment for the plants existing on it.

Another instance of active intervention is that there is a microbe found in ferruginous springs, or stagnant pools, which produces a deposition of an iron salt from this water, and when the microbe dies the deposition stops.

These facts were, more or less, admitted for some time before the germ theory of disease had been demonstrated in any instance. The growth of confidence in this theory proceeded through different stages of evidence. Guesses and suggestions of its truth had been offered to the public and to the medical profession many times before. Pasteur, a chemist, prepared its first stage by his researches on the different ferments, showing each form of fermentation had its specific form of micro-organism as its cause. It was not unnatural to connect disease with a fermentative process in connection with the human or animal body. There resulted active examinations of blood and serum and the animal tissues by different experimenters.

Davaine first proved that bacilli found in the blood of what is called "Splenic Disease" were the cause and not the consequence of the disease. This was another and important stage, and in very quick succession have followed demonstrations of the causal connection of specific microbes in quite a number of diseases.

A popular audience can not be led through all the elaborated and complicated evidence which appeals to a professional or scientific one, but there is a body of knowledge before the public now long enough that ought to be conclusive as to the germ theory of disease. We cite first the case of the disease produced by the Trichina spiralis. This is of the animal kingdom, but microscopic, and its connection with trichinosis in the human subject so often proved, that the public at large has accepted it, and we have seen that our Government has been obliged to give it National recognition in its management of our foreign commerce. Another body of knowledge the public have been educated to: that is, the fact of the wonderful success in surgical operations and in the prevention of all

forms of blood-poisoning, by the application of antiseptic precautions, having for basis the germ theory of disease. Hospital statistics everywhere show this. This evidence appeals to every family in the land, and requires no complicated demonstration.

We come to another stage in the development of these studies. These micro-organisms do not simply act mechanically. But in their living and dying, a very short period often, there are elements produced which have, in numerous instances, been proved to be very poisonous. This discovery has brought workers more to the chemical, instead of the biological, aspects of the subject. These products have been called ptomaines, diastasis, etc., and are the direct agents in the production of specific diseases. They have not been isolated in all cases, even where we are satisfied that germs or microbes are directly the true cause concerned, but time will most probably develop them. To antidote these deadly poisons is now the object of very much laborious work. These antidotes have been found and proven successful in a number of instances, mostly in animal diseases, but not always. The practice is in effect a vaccination, by which abolition of a natural susceptibility to a disease is brought about. The process of preparation is very difficult and subtle, and need not be explained here. We can, however, give some results recently published by Dr. Armand Ruffer, of England.

There is a disease of cattle called "black-quarter," which attacks cattle. It has its bacillus and doubtless its "ptomaine" or active principles of the disease. An attenuated form of the virus is made and the animals are inoculated. In France 5,835 cattle were inoculated; mean mortality before was 10.84 per cent., and not infrequently it was 17 per cent. After inoculation mortality fell at once to 2.15 per cent. In Switzerland, in 1884, 2,190 animals were inoculated. Of these .22 per cent. died; of the unvaccinated cattle 6.1 per cent. died. Much more evidence of same kind can be produced, as to the disease. Of more direct interest to us is the record in regard to inoculation for rabies or hydrophobia. Dr. Ruffer has collected most of the statistics on the mortality of persons bitten on any part of the body, and before vaccination was

practiced, and found it varied between 15 and 50 per cent. He assumes, however, 15 per cent as the correct figure.

In Table A of his statistics, which includes only persons known to have been bitten by dogs undoubtedly rabid, the figures show the total mortality to be a little over one per cent. *Before* Pasteur's treatment was applied, the mortality among people bitten in the face was 80 per cent. In the years from 1885 to 1889, 593 persons bitten in the face were inoculated at the Pasteur Institute. The total mortality is 2.23 per cent.

Tetanus or lock jaw is a disease of which we all have, very justly, a horror. It is found to be an infectious disease, and to be produced by a bacillus, which is found in and on the soil—on manure piles and in stables, and is very widely diffused over the globe. An active principle, called tetanin, has been produced by cultivation, that, injected into animals, will produce symptoms of tetanus. Attenuations of this have been used, and successfully, in curing the disease in animals. These examples are enough to prove the relations which these impurities of the atmosphere, etc., bear to disease, as well as the great advance made in antidoting such deadly poisons as these diseases or bacilli bring with them The discovery of these disease-producing active principles has eliminated almost entirely the idea of cold as a cause of different diseases, as, for instance, in the case of tetanus. That element of weather has not near as much to do with producing disease as formerly supposed.

Pneumonia, of which there is so much dread in every family nowadays, is now known to be an infectious disease, though it is not definitely settled as to the direct infecting agent. The popular and even professional explanation has been that cold was its sufficient cause. That, however, can be only a predisposing cause. The true one is a microbe, or probably two, and their products. They are nearly always present in the secretions of the mouth in a harmless condition. They are in a state of masterly inactivity until the system is prepared by some fault in our habits — indiscretions in diet, until certain autoxic or self-poisoning states arise; some depression from sudden cold and humidity which the system resents by chilly sensations. Then the soil is ready for this very active

microbe. We have before us a table of the mortality from pneumonia in Cincinnati for ten years, from 1881 to 1890, inclusive, compiled from Cincinnati Board of Health reports. For December, January, February and March we have 2,316 deaths. For June, July, August and September 823, not much more than one-third of the number. The year 1884 had an immense rainfall, as we all know, and was followed in January and February, 1885, by a great increase in death rate from pneumonia, namely, 123 in January and 104 in February. These statistics can be paralleled by those from many different sources and countries.

These figures, with reference to seasonal prevalence, do not exclude the bacterial influence. But they at least sustain the idea of the depressing effect of cold upon the system, and at least some agency in impairing its power of resistance.

We have all become sufficiently familiar with the complications of our influenza epidemic, now past, to know that pneumonia and its microbe and its toxic element have obtruded their dangerous interference, and that without any question of cold as a cause. The microbe of the influenza, by its virus, depresses the system and opens the way for the pneumonia virus. Such cases become what physicians know as "Mixed Infection," and are, therefore, the more dangerous.

Phthisis pulmonalis or consumption has, by Koch's discovery, been eliminated from the list of diseases caused by cold. It is generally believed now to rank as a microbic disease. Koch's proposed cure was worked out on the plan of an attenuation of the virus peculiar to the bacilli tuberculosis. It is a solace for a consumptive patient to feel that the aggravations of his disease are traceable to a cold, but his physician interprets them as the evidences of progress in the destructive work of the microbe and its virus.

Most of human infectious diseases have their greatest development during the cold months. Tonsillitis, diphtheria, croup, scarlet fever, etc., prevail mostly in Winter, but they show such specific differences and such infectious phases as not to be explained by a single cause, like that of cold or heat.

Instances of this complex relationship between external conditions and internal predisponents and diseases are found during the hot months of the year. Experiment has shown

that excess of heat may produce disease and destroy life, but that direct effect is rare in conditions of daily life. Usually a predisponent intervenes to complete the connection. Instances of Summer or hot weather diseases are Asiatic cholera, cholera infantum, heat stroke. yet they are largely more fatal under the influence of bad habits and various other predisposing causes. Indirectly, heat will develop various toxic substances in food, and then serious attacks of illness may result, as in cheese, fish and ice cream poisoning.

It will be a familiar statement to most people that neuralgias, headaches and rheumatic pains are importantly related to the meteorological elements above enumerated. Probably the most complete effort ever made to differentiate the factors most concerned in this result is the one initiated over fifteen years ago, by Dr. Weir Mitchell, of Philadelphia, with Captain Catlin, of the United States Army, as his patient, and carried on since then with infinite patience by the Captain. In 1864 he was wounded below the knee and the leg amputated. As happens at times, it left what is known as a neuralgic stump. He has ever since suffered neuralgic attacks. He has, within a year, given the medical profession and others the results of his long work. We herewith give his main conclusions. He has platted his observations on a system of curves, in connection with curves of weather observation: "The comparison of the weather elements, such as pressure, temperature, force of wind, humidity—relative and absolute, days of rain, depth of rain, hours of sunshine, number of storms and ozone with pain, covers a period in no case of less than five years. Of these the increasing temperature curve, the hours of sunshine curve, and the absolute vapor curve, operate to diminish pain, while all the others are identified more or less with pain." During great magnetic storms pain of unusual intensity prevailed. "Maximum pain bears a direct proportion to storm frequency, and an inverse proportion to temperature and elastic force of vapor, and minimum pain bears an inverse proportion to storm frequency, and a direct to temperature and elastic force of vapor; while depth of rain accompanies the number of storms and maximum pain. Charts of relative storm frequency and geographical pain charts are thus related. He found that the eastern edge of the neuralgic crescent lies

more than six hundred miles, or about twenty-three hours to the east of the center of the "Lows." Dr. Mitchell's own conclusions, given from observations on this case, in 1877, are: "Every storm, as it sweeps across the continent, consists of a vast rain area, at the center of which is a moving space of greatest barometric depression, known as the storm center, along which the storm moves like a bead on a thread. The rain usually precedes this by 550 to 600 miles, but before and around the rain lies a belt, which may be called the neuralgic margin of the storm, and which precedes the rain about 150 miles." Clinical experience has long since noted the effect of combined cold and wind in producing neuralgia.

The relations of water to disease appear in the various forms of myths prevalent among large numbers of savage tribes and nations. As Tylor, in "Primitive Culture," vol. 2, p. 208, says: "In all that water does, the poets fancy can discern its personality of life. It gives fish to the fisherman, and crops to the husbandman; it swells in fury, and lays waste the land; it grips the bather with chill and cramp, and holds with inexorable grip its drowning victim.

"Tweed said to Till,
What gars ye rin sae still.
Till said to Tweed,
Though ye rin wi speed,
And I rin slaw,
Yet where ye drown ae man,
I drown twa."

Survivals of these myths appear even in times not very remote. "In Australia special water demons infest pools and watering places. In the native theory of disease and death, no personage is more prominent than the water spirit, which affects those who go into unlawful pools, or bathe at unlawful times, the creature which causes women to pine and die, and whose very presence is death to the beholder, save to the native doctor (an important exception), who may visit the water-spirits' subaqueous abode and return with bleared eyes and wet clothes to tell the wonders of their stay."

"Carver mentions the habit of the Red Indians when they reached the shores of Lake Superior or the banks of the Mississippi, or any other great body of water, to present the

spirit who resides there some kind of offering." Franklin saw a similar sacrifice made by an Indian, whose wife had been afflicted with sickness by the water-spirits, and who, accordingly to appease them, tied in a small bundle a knife and piece of tobacco and committed them to the rapids.

The Bohemians will go to pray on the river-bank where a man has been drowned, and there they will cast in an offering, a loaf of raw bread and a pair of wax-candles. On Christmas eve they will put a spoonful of each dish on a plate, and after supper throw the food into the well, with an appointed formula, thus:

> "House-father gives thee greeting,
> Thee by me entreating
> Springlet, share our feast of Yule,
> But give us water to the full;
> When the land is plagued with draught
> Drive it with thy well-spring out."

"Perhaps Welshmen no longer offer cocks and hens to St. Tecla at her sacred well and church of Llandegla, but Cornish folk still drop into the old holy wells offerings of pins, nails and rags, expecting from their waters cures for disease, and omens from their bubbles as to health and marriage."

Between this mythological standpoint and our present one, much hard work has been done. It has consisted principally of chemical investigations, until a recent period. There was no provision in the savages animistic theory of nature for anything except the satisfaction of his fears. He looked to a propitiatory sacrifice, but not to any practical provision for his wants. He satisfied them as he came to the river, lake or spring, nor was it necessary that in the midst of nature's abundance he should do otherwise. But when there came an aggregation of individuals in towns, communities, or cities, some provision was necessary for continuous and certain supply.

In estimating its quality, the unaided senses were relied upon for testing it. The more scientific methods have not even yet supplemented them. They can give you information as to color, odor, sediment and taste, so that a fair judgment may be rendered. The standard requires water to be colorless or nearly so—without odor, free from sediment and without

unpleasant taste—though we know there are differences in taste between specimens of water that are equally harmless, or healthy. There is no precision in a standard established by such imperfect tests; as far as they go they have a value.

The next method in historical sequence is the chemical one. Simple as water is in its constituent elements, its chemical analysis was always difficult by reason of the amount of foreign ingredients, which its solvent powers enabled it to hold. There must be wondrous skill in nature's laboratories, when we see waters issuing from thousands of springs that are so varied, subtle, selective, constructive and constant in their ingredients. At that time they are pure, and scarcely not one of them contains an ingredient that will prove acutely toxic to the consumer. The potentiality of poison begins afterward, and, as we shall see, usually after man has impressed them into his service.

The chemical standard admits of great precision, though variations are found. The usual saline ingredients are not necessarily hurtful, they are often helpful in nutrition. After all of the amount of chemical work applied to the determination of a standpoint of purity, the most important ingredient, so far as disease is concerned, is the organic matter. Chemistry can not say exactly what is a harmful amount. It will give some help in ascertaining its origin, as, for instance, in sewage contamination. Perhaps, in this country, the best work of this kind in our country has been done in Massachusetts, under the auspices of the State Board of Health. Dr. Walcott* of that Board states that their examinations have shown that the amount of chlorine may be assumed as the standard, "That it survives all the changes" that mixtures of sewage and water undergo. They have constructed a chart, which shows all the sources of equal amounts of chlorine, which, being connected as isobars on weather maps, are called "Isochlors." When a water brought in for analysis shows an amount of chlorine greater than that designated by the "Isochlor" of that locality, the presumption of pollution by sewage, more or less remote, is seldom a mistake. This is as simple a standard as we know of.

After all, our most conclusive knowledge as to the relations

*Association American Physicians, Vol. 6, p. 222.

of water to disease is that which clinical experience has given. As far back as 1848 and 1850, when cholera was prevailing in London, Dr. Snow noticed that in one neighborhood, where many people were using water from a well, a considerable proportion of them sickened and died from cholera. He believed that it was due to contaminations from cholera excreta, and proved great organic contamination. He maintained that the contagium was particulate and living, but methods now available were not so then. The repetition of such sources of infection have been so frequent since that the evidence is convincing to both the professional and non-professional public; yet such waters have been so apparently pure, that in the early experience of such cases, people would insist upon using them. More than a hundred of such demonstrations of the connection of impure water with typhoid fever have occurred in England and the United States alone. Dr. Walcott says, in regard to the Merrimac River: "There is nothing in the appearance or taste of the water to deter a community from its use, nor does the chemical analysis indicate a water too polluted for drinking." Yet the following are his figures in regard to the two cities of Lowell and Lawrence, situated on that river: "The average death rate from typhoid fever for all the cities of Massachusetts, for twelve years, from 1878 to 1889, was 4.62 per 10,000; for the same period the rate in Lowell was 7.63 and in Lawrence 8.33 per 10,000. For the four years—1886–89—average rate in Lowell per 10,000 is 9.55 and 10.30 for Lawrence; while in the other cities in the State the rate was 4.59. Scarlet fever has been transmitted through milk, diluted with water, where families have had scarlet fever, also diphtheria.

Some years ago, when our Deer Creek was a center for pork killing and packing, for two Winters there was prevalent an obstinate and serious form of dysentery. A committee was appointed by the medical society to report upon it. I was chairman, and we found that the Deer Creek sewage was being pumped into our reservoir, and that the disease prevailed only among the consumers of the city supply; others, who were using other sources of supply, were exempt.

Much more might be said on this particular branch of our subject. We come now to new methods of water examina-

tions — that of the bacteriological. If the air be full of microbes the water is almost equally so. Many of them are harmless, but it is a vehicle or source of nutrition for the good and bad alike. If chemical analysis gives us a test of organic impurities, and clinical experience locates these impurities in well or river, bacteriological examinations discover the guilty individuals in certain microbes and their toxic products. The germ theory finds "confirmation" in the precise connections of bacterial growths in water with disease. The methods are so complete that the number of microbes in each cubic centimeter have been counted.

Miqual (Bacteriological Analysis of Waters, p. 488) gives following figures as to bacteria in one cubic centimeter:

MIQUEL'S STANDARD OF PURITY IS AS FOLLOWS.

	Bacteria to cubic centimeter 17 minims.
Water exceedingly pure	0 to 10.
Water very pure	10 to 100.
Water pure	100 to 1,000.
Water mediocre	1,000 to 10,000.
Water impure	10,000 to 100,000.
Water very impure	100,000 and more.

WATERS OF THE RIVER SEINE—IN AVERAGES BY SEASONS.

	At Ivry.	At St. Main.	Ourcq.
Winter	43,500	63,940	84,955
Spring	26,570	14,490	19,780
Summer	13,710	10,140	8,105
Autumn	46,340	56,640	100,485

His numerous experiments have established that these waters are most pure in Summer—July, August and September. No relation then exists between the temperature of the water and its wealth in micro-organisms. The sewer waters of Paris, on an average, contain 13,800,000, demonstrating the great immense bacterial contamination in those places, as compared with outside waters. These waters, filtered through the soil when returned to Seine, are 1,800 times purer. Some of them, filtered through an artificial filter of soil about six feet thick, lose about 999 of every 1,000 bacteria—having originally 20,000,000 to the cubic centimeter (17 minims). These few facts demonstrate the purifying effect of filtration

through soil. But the one all-important fact in regard to the purification of water is that boiling is absolutely necessary, and then protection from further contact with impurities in air and vessels.

The rapid deposition, from the atmosphere of microbes, in water, while being exposed to the air, requires that, for purposes of analysis especially, the specimen be perfectly protected from the air, or that the analysis be made at the place from which the water is taken.

The waters so crowded ultimately become poisonous to the bacteria, or the food required becomes exhausted, so that there is a purifying process going on in that way. A Black Hole of Calcutta sacrifice takes place.

The water of the soil for variable depths below the surface, or to a point where drainage is obstructed by impermeable strata, is called the "Ground-Water." It is found that this water furnishes a large proportion of supply to wells or superficial basins, and is especially rich in bacteria and liable to infection. The closer the level of this ground water to the surface the more rapidly the air above becomes impure with carbonic acid and bacteria, which are present in the soil. If the water level lies uniformly close to the surface, it forms an unhealthy condition of dampness of soil, which is favorable to the production of such diseases as consumption and typhoid fever. If the water level is far below the surface it gives you a dry soil, favorable to the activity of such bacteria as find food and living there, and to the production of carbonic acid. In the fall of the year, when the ground water is at its lowest, typhoid fever develops. A rise again to its highest level brings to the surface the carbonic-acid gas and the bacteria to the atmosphere, and there is again chance for infection, but the soil is not then so fit for farther growth of carbonic-acid microbes — not until recession again occurs. These statements have been illustrated in the history of epidemics of typhoid fever that have occurred in Berlin, Munich and other places. This ground-water, in its variations of movement up and down, may, in its upward movement, force impure air into houses. It has been shown by exhaustive experiments by Pettenkoffer and by Marker and Shultze, that in a room with an external temperature of 32°,

the internal being 34° higher, all openings in the wall being sealed, 1,066 cubic feet of air passed per hour through the walls and floor into the room and up the chimney. Again, with a difference of only a few degrees between the internal and external temperature, it was found that the air passing through a superficial yard of wall line per hour varied 4.7 cubic feet for sandstone, 7 and 7.9 for brick, 10 for tufaceous limestone to 14.4 for mud. The bearings of these facts upon cellar and first-floor rooms for habitation are evident.

Ice, formerly supposed to be a purifier, is now known to be quite infectious at times — contains microbes in considerable numbers — and has produced local outbreaks, notably in the case of a hotel at Rye Beach, N. H., where the ice was obtained from a pond to which much sawdust and debris had drifted.

PURIFICATION OF WATERS.

Recent investigations show that the self-purification of rivers is due to three main factors:

1. The rush of pure water and the consequent dilution of the impure substances.

2. The chemical processes which take place under the influence of the atmospheric oxygen and of micro-organisms, and perhaps also the intervention of aquatic plants.

3. The deposition of the heavy substances, and the mud on the bed and sides of the river.

"All of these researches have more or less completely demonstrated that the organic substances, the ammonia, the bacteria, introduced into the waters of the rivers that have been studied, diminish at a comparatively short distance from the point of pollution, while at the same time those products increase which indicate that oxidation has taken place, such as nitrous and nitric acids."

(The Sanitary Record, February 1, 1892, p. 381.)

The former belief in regard to purification of running water in rivers, etc., was that within short distances the oxidation of the impurities and their neutralization was secured by motion and the presence of the oxygen in the water. Since the introduction of bacteriological methods, that is not relied upon. Though chemical examination may

determine the amount of chlorine as a test of sewage impurities, yet the main reliance is to be placed on the bacterial tests, especially with reference to typhoid fever.

We have thus given an imperfect review of the factors in our environment, pertaining to weather, water and disease, and indicated to some degree how they can injuriously affect the individual. It remains now to consider what opposing forces the individual can bring to bear, in order that he may counteract the unfavorable conditions to which his environment may expose him

It may be said in a general way, that it is a testimony to the successful contest of a nation with the forces of nature where it grows in numbers, without extraneous additions, when the proper proportion between births and deaths is maintained, when it advances in arts and sciences and enjoys all the comforts of life, when it has been able to control some of the most dangerous forces of nature, and make them minister to its happiness.

But in this aggregate of life and activity the individual must carry on his own struggle for existence, so far as it concerns his health.

The superstructure of life is built mainly on the basis furnished by heredity. While it may be said that no one is exempt from influences producing disease, yet the liabilities are diminished very much in the case of him or her, who most nearly approaches the physiological standard. This approach can be estimated numerically in a few particulars. Numerous investigations, physiological and clinical, have shown that there is a close relation between pulse, respiration and temperature, expressed generally as 70 to 75 for pulse; 16 to 18 for respiration, and 98½ for temperature in the adult. Any persistent variation from these figures is reason to suspect disease of some sort. They are representative of the important functions of the heart, the lungs and the complex phenomena of nutrition, including chemical and nervous activities. We know that nervous excitement, or shock, will accelerate the movements of the heart and lungs and seriously derange our digestion. Insurance companies have their standards, and may be considered as forming a body of select livers, but they estimate eligibility on the basis of a single

examination, and can take very little count of future changes. They include the important matter of family history or heredity and predispositions, and form their conclusions. The army standard is intended to secure healthy men; and is a reliable one. Both of these standards fail in properly estimating the personal equation pertaining to every one, or the amount of reserve force available, or how far conclusions based on heredity may be subject to variations. It is necessary, therefore, that your constitution should be kept up to its highest point, and also that you should hold a stock of reserve force, for in time of sickness it will hold you in good stead. If your health account is on the debtor side when the epidemic comes, or pneumonia prevails, you may easily become irretrievably bankrupt.

In the way of protective influence for the individual we may refer to a well-known fact that in families there are some members, or even all of them, who have an amount of exemption from prevailing disease, by which they escape infection altogether, or receive it in perfectly safe quantities, so that their illness is without danger. This is called natural immunity, in contradistinction to acquired immunity, which is brought about by artificial means.

This question is now the subject of much experimental work and thought. It is admittedly not yet solved. Instances of natural immunity among animals may be mentioned. No undisputed case of typhoid fever transmitted to animal from the human being has appeared. Injections of human saliva, which contain the micro-organisms of pneumonia, will kill a house mouse in a few hours, as stated above, but will not affect a field mouse. Probably the healthier habits of the latter, his nomadic life, are the cause of this difference. Inoculations with the glanders bacillus will destroy a guinea pig, but will produce only slight effect on a rabbit. Cattle are immune against glanders. In the serum, or what may be called the watery portion of the blood, is supposed to reside that power of producing immunity from certain infectious diseases. As for instance, in tuberculosis. The serum of the dog has been used in a human subject as being antidotal to the bacillus of tuberculosis and its products. The question as to what element in the blood serum it is which produces

immunity is just undergoing earnest study. There is another theory as to how bacterial growths and products can be disposed of after getting access to the body. A French investigator has proven, under the microscope, that the white blood corpuscles, or leucocytes so-called, which have the power of motion, will, by a slow movement, absorb the bacillus, which is much smaller, and by a sort of digestive process destroy the bacillus, and thus put it out of the way of doing farther harm. This can not be called a battle of giants, for the corpuscle is about $\frac{1}{2500}$ of an inch and the micro-organism much smaller, $\frac{1}{25000}$. It depends upon the comparative strength of bacillus, or leucocyte, or blood corpuscle, whether the individual become infected or not. To read some of the accounts of this procedure, we would fear that the personal element of the mythological era was returning to the scientific age. It reminds one of the eager action of bass or trout when the fisherman casts his fly on the waters. It is snapped up in short order.

The other form of immunity is acquired. Vaccination for small-pox is an instance. One attack of scarlet fever or measles or typhoid fever generally prevents return. Attenuation of bacterial virus is being used to produce immunity against certain diseases. Pasteur's vaccinations for sheep disease, hydrophobia, etc., are some of the earliest results of immunity acquired in that way; more recently the attenuated virus of the pneumonia microbe has been used to prevent and relieve pneumonia. Also, the attenuated virus of diphtheria has been used with success for the same purpose in animals. The duration of the immunity varies considerably. It is not an impossible thing that, in the future, compulsory vaccination for consumption may become a law. These experiments, so far, have been nearly all on animals. One result of this practice, in six cases of pneumonia in the human being, was a reduction of 3° to 4° within twelve hours. Our capacity for defense against disease is limited in a very remarkable way.

Bacteriological work has disclosed a series of results which show how one may be made liable to the inroads of disease. It is now known that the human system, with its complexities of function and structure, becomes at times autotoxic or self-poisoning. If the action of the skin become suppressed, and

its elimination of fluid and solid matters be suspended by cold and moisture, or if open sores or wounds exist on it, or on the mucous surface of mouth or throat, if digestion be interfered with by food improper in quality and quantity, or if the entire range of processes of preparation of food for assimilation be interfered with, poison of a deadly character may develop. A great many chemical poisons have been found in the fluids and tissues of the body; each organ of the body may contribute its quotum, and some of them are, when injected into the body of animals, deadly in their effects; so-called biliousness is explained in this way. The headache, bad taste, dry tongue, pain in the body and limbs, malaise, indifference and inability to work, and sleepiness, are the results of "ptomaine" poisoning. This word is applied to a class of these agents which chemists and bacteriologists have found in our bodies. Taking cold is not simply the result of exposure to winds or sudden alterations of weather, but the ptomaines poisoning has opened a way for these "sappers and miners," micro-organisms and their stealthy work.

If microbes, with their minute anatomical structures and limited lives, can produce such mischief to human beings and animals, what may not be expected from the complexity of structure and function in a human being when its vital chemistry becomes perverted. It is no wonder that in this new field of animal chemistry have been found so many complex organic poisons that may interpose their deadly effects. An atom of vegetable matter in microbe form, in the process of living and dying, leaves a legacy of virus that can infect ultimately the entire mass of huge animals; like a piece of wood on a railroad track, with the train at high speed, that will precipitate the immense mass of wood, iron and flesh into instant wreck. We have no reason to be proud in view of such possibilities.

Predisposition to disease qualifies the health in quite a number of instances. It is well known that families show these tendencies, and they dominate their pathological histories. The weak organs may be the digestive ones, or it may be the lungs that are abnormally sensitive. These predispositions show themselves at different ages, as, for instance, consumption between twenty and thirty. The children of a

family early show predispositions. They diminish the vigor of individuals and open the way for diseases other than that which the predisposition would produce. There is, however, a modifying effect in age, by which the predisposition disappears. If an individual, by heredity liable to consumption, gets beyond thirty years of age, his immunity increases each year beyond that time, and with care he may escape it entirely. Sometimes old age in such cases brings a decreasing immunity.

We may allude to another source of weakness in some portions of our population. The census returns for 1880 show that we had then a population of over 6,000,000 people foreign born. It is well known that the process of acclimatization makes its subjects more liable to disease, especially in their epidemic forms. The history of cholera, small-pox and scarlet fever in our city shows their greatest infringment on the foreign-born population. This result may be ascribed largely to the climatic changes and want of adjustment to them, which the native population have already secured. Considering the numbers above will give an idea of how much disease may be attributed to that part of our population.

The summary of this paper is as follows: An attempt to outline each factor of weather as an opposer to the individual — for there is no complete harmony between the two. While there is an appreciable influence in each component, it is in its association with one or more besides that we usually see and feel it. Types of weather are thus formed. Cold or heat with humidity; cold with wind. Another, heat and wind and low-air pressure are some of these types. Few efforts have been made to correlate exactly disease with a single factor, or with associated ones. Dr. Mitchell's and Capt. Catlin's are the most scientific and practical ever attempted. Besides these strictly meteorological elements, we have considered the ætiological effect of accidental impurities of the air and water and ground, such as dust, fog and bacteria. That the microbes of air and water and soil through their products or virus stand in closer causal relations to disease than mere meteorological elements. We have endeavored to signify, in a limited degree, what the defenses of the individual must be in the struggle—principally good health and certain immunities from liabilities to disease conferred by

nature, or acquired by the protective influence of one attack of a disease. Also, we have indicated the hopes and chances of artificial immunity in the use of attenuated virus of microbes. We think there is hope that this may become a great preventive, and a therapeutical or curative measure.

NORTH AMERICAN HELICOSPORÆ.

By A. P. Morgan.

The Helicosporæ is a section of the families of Hyphomycetous fungi, established by Saccardo, under which to arrange such genera, with their species, as are furnished with elongated spores that are spirally coiled. In my search for specimens of Hyphomycetes, a large part of the examples I have met with belong to this section, and the different forms seem well nigh endless. In my endeavor to arrange the species, I have found it impossible to separate them into genera by the characters of the hyphæ. But in the critical examination of great numbers of specimens, the observer soon becomes impressed with three types of spores; in the first the spores are long, slender, and flexible when wet, very sensitive to the influence of moisture; in the second and third, the spores maintain a rigid, fixed coil, which in the second is flat, and in the third is an oblong or ellipsoidal body. In the following arrangement, I have not been able to present all the species that have been reported in North America, but only those of which I possess abundant material for critical examination; most of these have been found living and growing by myself; the few species described from dried specimens are credited to the persons from whom they were received.

HELICOSPORÆ, Sacc.

Hyphomycetous fungi, with elongated spores spirally coiled.

1. Hyphæ and spores not involved in mucus. (*Mucedineæ* and *Dematieæ*.)

Genus I.—Helicomyces, Link.

Hyphæ creeping, septate, branched, bearing the spores on minute lateral teeth or at the apex of short lateral branches. Spores long, filiform or linear, hyaline, loosely coiled into an irregular or flat spiral.

The spores in this genus are very susceptible to the action of moisture.

a. Spores filiform, the thread about 1 mic. thick.

1. HELICOMYCES OLIVACEUS, Peck. Effused, forming a thin, flocculose, olivaceous stratum. Fertile hyphæ, simple, erect, rigid, tapering, septate, black, seated upon a net-work of very fine, delicate, creeping hyaline threads: the spores borne in a spicate manner, on minute pellucid teeth, along the lower half of the thread, leaving the upper part naked. Spores filiform, hyaline, indistinctly guttulate, usually coiled about three times; the thread 70–90 mic. in length and scarcely 1 mic. in thickness. (Fig. 1.)

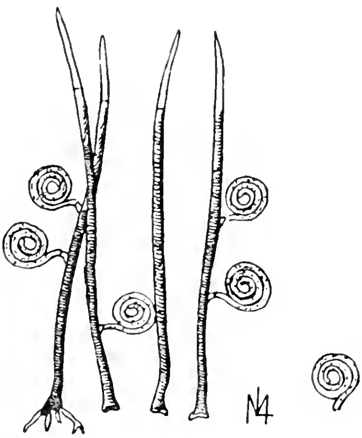


Fig. 1. Helicomyces olivaceus.

Growing in small patches on old wood of Acer, Liriodendron, etc. The black points of the fertile hyphæ appear above the greenish stratum of the spores; they are 175–250 mic. in length by 4–5 mic. in thickness.

2. HELICOMYCES GRACILIS, Morg., n. sp. Effused, forming a thin, flocculose, greenish-yellow stratum. Hyphæ creeping, septate, branched, greenish-hyaline; the

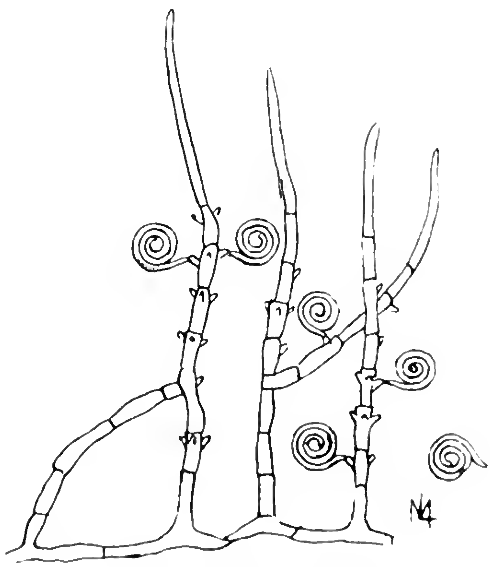


Fig. 2. Helicomyces gracilis.

spores borne on minute pellucid teeth, along the lower part of ascending fertile branches. Spores filiform, hyaline, continuous, usually coiled about three times; the thread 70–90 mic. in length, and about 1 mic. in thickness. (Fig. 2.)

Growing in small patches on old bark of Sassafras. While the spores in this species are similar to those in *H. olivaceus*, the hyphæ are very different; the ascending greenish-pellucid fertile branches are similar to the creeping hyphæ, and sometimes they are branched.

b. Spores linear, the thread 2.5–3 mic. thick.

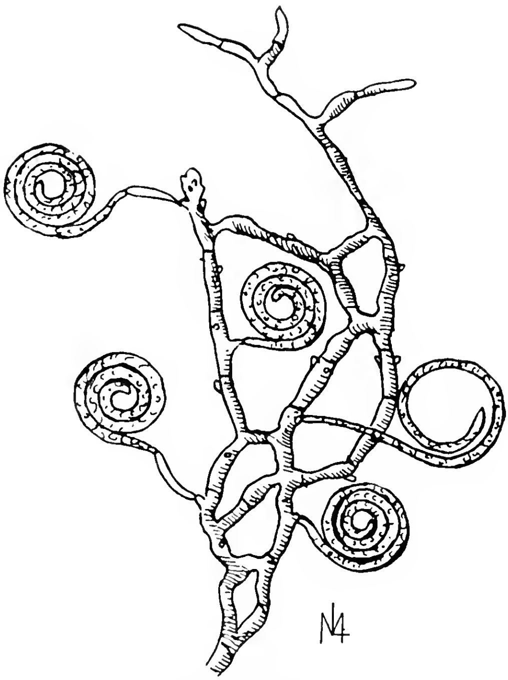


Fig. 3. Helicomyces cinereus.

3. HELICOMYCES CINEREUS, Peck. Effused, forming a cinereous, velvety stratum. Hyphæ creeping, much branched, with long, flexuous, ascending branches, septate, brownish-hyaline, bearing the spores on lateral teeth or pedicels of the prostrate stems and branches. Spores linear, hyaline, guttulate, coiled quite regularly 3–4 times; the thread 160–190 mic. in length, and about 2.5 mic. in thickness; the inner extremity acute, the outer obtuse. (Fig. 3.)

Growing on old wood and bark of all kinds, and very common. The ascending, flexuous branches rise above the stratum of spores; the hyphæ are twice as thick as the thread of the spores; there is often an intervening, short, hyaline pedi-

cel between the spore and the minute tooth of the hypha; sometimes it falls off with the spore, sometimes it stays on the tooth, but usually it is deciduous from both.

4. HELICOMYCES BELLUS, Morg., n. sp. Effused, forming a thin, flocculose stratum, gray with a pinkish tinge. Hyphæ creeping, septate, branched, brownish-hyaline, bearing the spores on minute lateral teeth. Spores linear, hyaline, guttulate, faintly multiseptate, coiled quite regularly 2½–3½ times; the thread 140–180 mic. in length by 2.5–3 mic. in thickness; the inner extremity acute, the outer obtuse. (Fig. 4.)

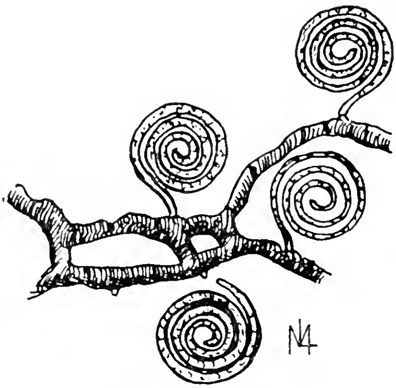


Fig. 4. Helicomyces bellus.

Growing on old wood of Liriodendron, Juglans, etc. The hyphæ creep close to the substratum and are nearly concealed by the abundant spores: they are nearly twice as thick as the thread of the spore.

5. HELICOMYCES SCANDENS, Morg., n. sp. Effused, forming a rose-colored, setulose stratum. Hyphæ climbing, hyaline, septate, branched, bearing the spores in dense clusters on minute lat-

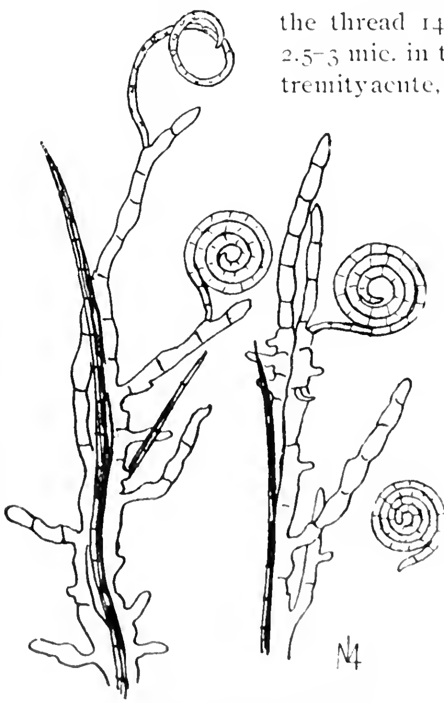


Fig. 5. Helicomyces scandens

eral teeth. Spores linear, hyaline, sometimes guttulate, faintly multiseptate, coiled 3–4 times; the thread 150–200 mic. in length, 2.5–3 mic. in thickness; the inner extremity acute, the outer obtuse. (Fig. 5.)

Growing on old wood and bark of Oak, Hickory, etc. The habit of this plant is very peculiar; it is exactly that of the species of Graphium. The hyaline threads run constantly in parallel bundles, but I have not been able to satisfy myself that the black pointed threads which they usually inclose are not the erect stems of some old black mould. This is an abundant species.

c. Spores linear, the thread 4.5–6 mic. thick.

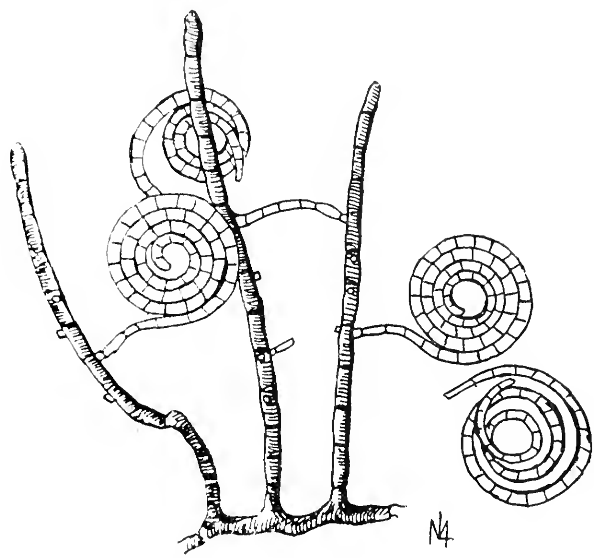


Fig. 6. Helicomyces fuscus.

6. Helicomyces fuscus, B. & C. Effused, forming a thin, brown, pubescent stratum. Hyphæ brown, creeping, septate, sending up long, simple, ascending branches which bear the spores laterally on minute hyaline teeth. Spores linear, brownish-hyaline, multiseptate (40–50), coiled usually 3–4 times; the thread 350–450 mic. in length, 5–6 mic. thick in the middle, tapering gradually, and 3–4 mic. thick at each of the obtuse extremities. (Fig. 6.)

Growing on old wood of Oak, Maple, etc. The fertile branches are 200–250 mic. in length by 6–7 mic. in thickness. The spores have the appearance of being furnished with a short pellucid pedicel. This is an elegant species.

7. HELICOMYCES CLARUS, Morg., n. sp. Effused, forming a thin, tomentose, pinkish-white stratum. Hyphæ creeping, septate, branched, hyaline, with the spores terminal on short, lateral branches. Spores linear, hyaline, guttulate, in linear series, coiled irregularly; the thread 180–220 mic. in length, about 4.5 mic. thick at the thickest part and tapering gradually to each end; the extremities obtuse. (Fig. 7.)

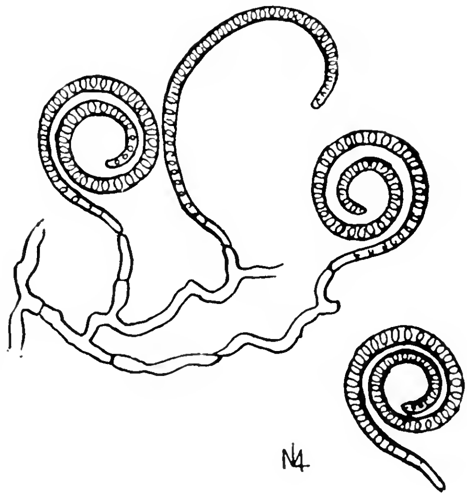


Fig. 7. Helicomyces clarus

Growing on old pod of *Tecoma radicans*. The hyphæ creep very close to the substratum. Most of the spores in the specimen were pellucid and continuous; the large elliptic, shining guttulæ of the well-developed spores are quite characteristic.

8. HELICOMYCES ELEGANS, Morg., n. sp. Effused, forming a thin, flocculose stratum, flesh colored or pale rose-color. Hyphæ creeping, septate, much branched, brownish-hyaline, bearing the spores on lateral teeth and at the apex of lateral branches. Spores linear, hyaline, irregularly coiled, multiseptate (40–50); the septa commonly indistinct; the cell-contents broken and confused; threads 240–310 mic. in length, 5–6 mic. thick in the middle, tapering gradually to 3–4 mic. at each obtuse extremity. (Fig. 8.)

Growing on old bark and wood of Platanus, Acer, etc. The bright-colored stratum is composed entirely of the very

large spores; the brown hyphæ creep very close on or beneath the surface of the substratum, and are much branched and entangled.

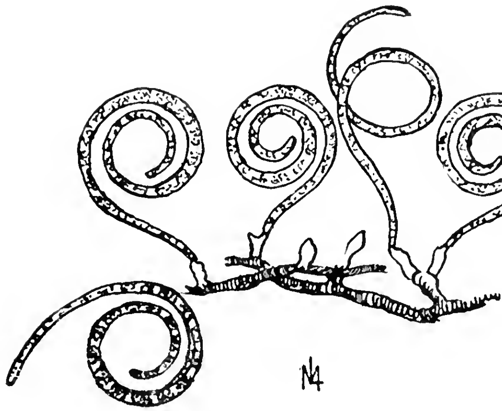


Fig. 8. Helicomyces elegans.

Genus II.—Helicoma, Corda.

Hyphæ creeping, septate, branched, bearing the spores on lateral fertile branches. Spores rather thick, usually septate, hyaline or sometimes brownish, closely coiled into a flat, fixed spiral.

The spores in this genus are not hydrotropic.

a. Spores in a single coil.

1. Helicoma larvale, Morg., n. sp. Effused, forming a thin, puberulent stratum, dirty-gray or brownish in color. Hyphæ stout, thick, much branched, septate, brownish, the spores terminal on slender hyaline branches. Spores brownish, in a single coil, transversely 7-septate, with a fine, dark line running nearly midway lengthwise; the coiled spore 16–20 mic. in diameter; the thread 35–40 mic. in length, and

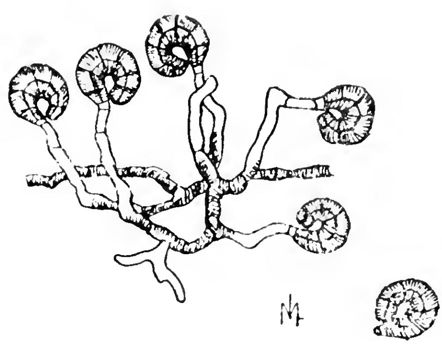


Fig. 9. Helicoma larvale.

about 8 mic. in thickness in the middle and narrower at each end; the basal segment hyaline and truncate, the apical extremity obtuse. (Fig. 9.)

Growing on old pod of *Tecoma radicans*. The young spores are hyaline and continuous, like their long, slender pedicel, but septa soon appear, and the fully matured spore is brown and uniformly 7-septate.

b. Spores coiled 1½ times.

2. HELICOMA AMBIENS, Morg., n. sp. Effused, forming a brown hirsute stratum. Hyphæ brown, creeping, septate, with ascending, flexuous, fertile branches, bearing a few scattered spores on minute lateral teeth. spores hyaline, 8-septate, the septa sometimes indistinct; coiled about 1½ times; the coil 14–17 mic. in diameter; the thread 50–60 mic. in length; about 6 mic. in thickness; the inner extremity obtuse, the outer obliquely acute. (Fig. 10.)

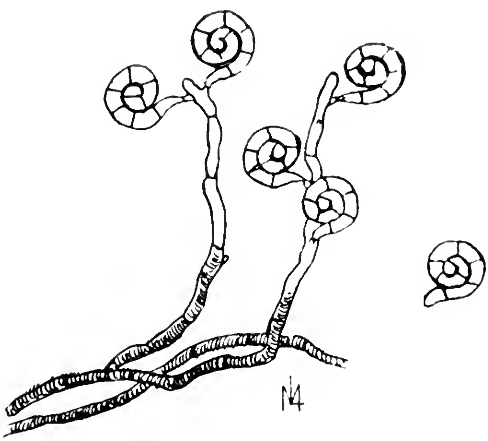


Fig. 10. Helicoma ambiens.

Growing on the inner bark of *Acer saccharinum*. The spore is at first hyaline and continuous; the septa appear one after another until the fully grown spore is uniformly 8-septate. I sometimes find old specimens in which the spores are tinged with brown and have added a few half septa, so as to appear 9–12 septate. This is a common species.

3. HELICOMA POLYSPORUM, Morg., n. sp. Effused, forming a thin, rose-colored stratum. Hyphæ intricately much branched; the branches short, thick, hyaline, covered everywhere by the dense layer of spores, which grow on minute obtuse processes. Spores hyaline, 12–15-septate, coiled about

1½ times; the coil 16–19 mic. in diameter; the thread 60–70 mic. in length, about 5 mic. in thickness; the inner extremity obtuse, the outer acuminate. (Fig. 11.)

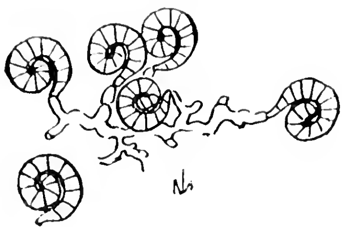


Fig. 11. Helicoma polysporum.

Growing on the inner bark of *Acer saccharinum*. The rose-colored stratum is a continuous mass of spores; the spore is quite regular in shape and very beautiful.

c. Spores coiled 2–3 times.

4. Helicoma repens, Morg., n. sp. Effused, forming a minutely flocculose, pinkish stratum. Hyphæ creeping, septate, hyaline, with very short ascending branches, which are covered by the abundant spores. Spores hyaline, multi guttulate, coiled nearly 2½ times; the coil 18–21 mic. in diameter; the thread 80–100 mic. in length, about 4 mic. thick; the inner extremity obtuse, the outer long and tapering. (Fig. 12.)

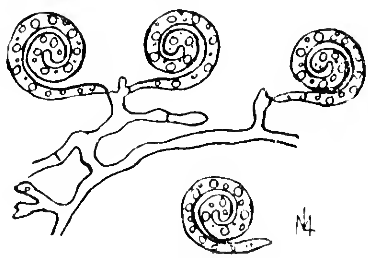


Fig. 12. Helicoma repens.

Growing on the inner bark of *Acer saccharinum*. The hyphæ are very fine and creep on or beneath the surface so closely as to be distinguished with difficulty; the colored stratum is formed entirely by the abundant spores. The guttulæ sometimes give the spore the appearance of being faintly septate.

5. Helicoma limpidum, Morg., n. sp. Effused, forming a minutely flocculose, pale stratum. Hyphæ creeping, septate, brownish-hyaline, the spores borne at the apex of short lateral branches. Spores hyaline, multiseptate (15–20); the septa sometimes indistinct; coiled 2–3 times; the coil 20–25 mic. in diameter; the thread 80–110 mic. in length, about 4 mic. thick; the inner extremity acute, the outer obtuse. (Fig. 13.)

Growing on old wood of Elm. The outer extremity of the spore does not taper, and is obtuse or sometimes truncate.

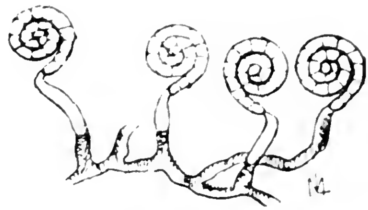


Fig. 13. Helicoma limpidum.

6. Helicoma Berkeleyi, Curt. Effused, forming a minutely flocculose, grayish stratum. Hyphæ brown, creeping, septate, branched, the spores borne at the apex of ascending lateral branches. Spores hyaline, multiseptate (18–30);

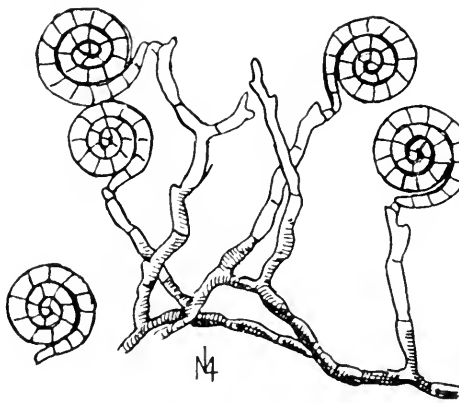


Fig. 14. Helicoma Berkeleyi.

the septa sometimes indistinct, coiled 2–3 times; the coil 25–35 mic. in diameter; the thread 100–150 mic. in length, 5–6 mic. in thickness, tapering slightly toward each end; the inner extremity obtuse, the outer subtruncate. (Fig. 14.)

Growing on old wood of Elm, Maple, etc. The spores sometimes have a shining, bronzed appearance, and I have found old specimens in which the spores had become brown. This is an abundant species.

d. Spores coiled 3–5 times.

7. Helicoma ambiguum, Morg., n. sp. Effused, forming a very thin, flocculose, rose-colored stratum. Hyphæ slender, creeping, septate, branched, hyaline, bearing the spores at the apex of lateral branches. Spores hyaline, the cell-contents broken up into irregular masses, and often with large, round guttulæ, irregularly and frequently indistinctly septate;

coiled 3–5 times, the spires rising one above another; the coil 40–50 mic. in diameter; the thread 350–400 mic. in

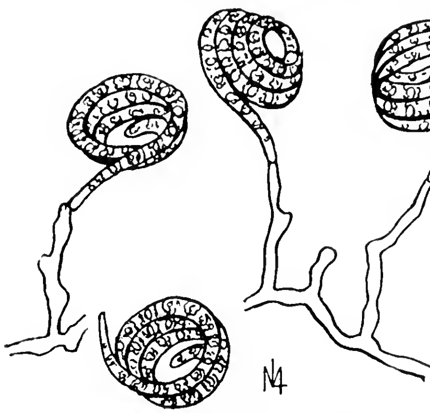


Fig. 15. Helicoma ambiguum.

length, 6–7 mic. thick in the middle and tapering gradually to each extremity. (Fig. 15.)

Growing on a patch of old Sphæriæ on wood of Platanus. The hyphæ appear to creep beneath the surface; they are more slender than the thread of the spores. This species tends toward *Helicoön*.

Genus III.—Helicoön, Morg., nov. gen.

Hyphæ various. Spores very large, spirally coiled into an elongated ellipsoidal body.

a. Spores hyaline.

1. Helicoön thysanophorum, E. & H. Densely cæspitose or sometimes effused, cinereous. Hyphæ brown, creeping, branched, bearing the spores at the apex of very short, erect branches. Spores hyaline, conic-cylindric, consisting of 8-10 spires rather loosely coiled; spore 25–30 x 15 mic.; the thread about 2 mic. in thickness. (Fig. 16.)

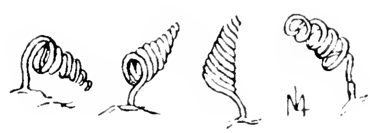


Fig. 16. Helicoön thysanophorum.

Growing on the pitchy bark of an old Pine log: Newfield N. J., *Mr. J. B. Ellis*.

2. Helicoön sessile, Morg., n. sp. Effused, forming

minutely pulverulent, pale stratum. Hyphæ consisting of extremely fine threads, running on and beneath the surface, so that the spores appear to be sessile upon the matrix. Spores hyaline, ellipsoidal, composed of 6–8 spires, closely coiled; spore 40–48 x 25 mic.; the thread 5–6 mic. in thickness. (Fig. 17.)

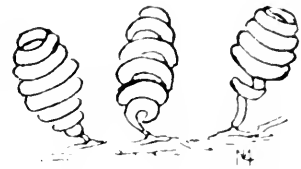


Fig 17. Helicoon sessile.

Growing on old wood of Elm. The spores appear to be sessile immediately upon the wood; the hyphæ are so fine as to be scarcely discernible.

b. Spores colored.

3. Helicoön auratum, Ellis. Effused, forming a thin, pulverulent, golden-yellow stratum. Hyphæ erect, septate, simple or rarely branched, brown below, the apex hyaline, each terminated by a single spore. Spores golden-yellow, ellipsoidal, composed of 12–15 spires, closely coiled; spore 37–44x25 mic.; the thread about 3 mic. in thickness. (Fig. 18.)

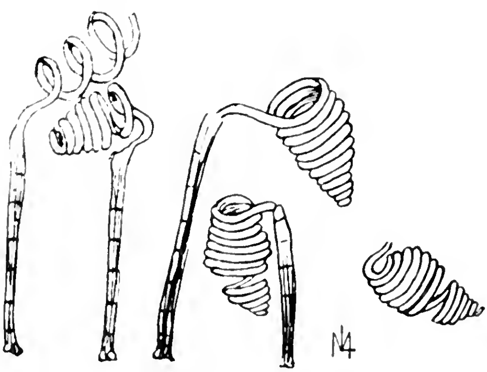


Fig. 18. Helicoon auratum.

Growing on old wood of *Acer rubrum*, Newfield, N. J., *Mr. J. B. Ellis.* The apex of the erect hyphæ at first runs out into a minute hyaline cork-screw; the coils continue to multiply and come closer together, gradually acquiring their golden-yellow color.

4. Helicoön ellipticum, Peck. Effused, forming a thin, velvety olivaceous stratum. Hyphæ abundant, creeping,

septate, olivaceous, intricately and somewhat reticulately branched, bearing the spores on minute lateral teeth. Spores

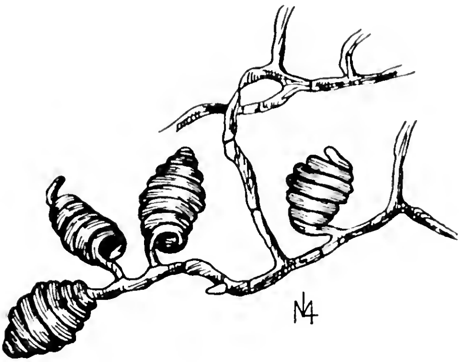


Fig. 19. Helicoön ellipticum.

olivaceous, ellipsoidal, composed of 6–8 spires, closely coiled; spores 30–36 x 20–24 mic.; the thread 3–4 mic. in thickness. (Fig. 19.)

Growing on Hemlock wood: Newfield, N. J., *Mr. J. B. Ellis*.

The spores are formed by the coiling of a lateral branch; they are very abundant.

II. Hyphæ and spores involved in a gelatinous or granular element (*Tubercularieæ*).

Genus IV.—Everhartia, Sacc. & Ellis.

Sporodochium superficial, verruciform; hyphæ very slender and delicate, branched, involved in a gelatinous mass; the spores borne at the apex of slender branchlets. Spores closely coiled into a flat, fixed spiral. The spores are similar to those of *Helicoma*.

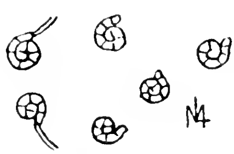


Fig. 20. Everhartia hymenuloides.

1. Everhartia hymenuloides, Sacc. & Ellis. Sporodochium verruciform, scattered, brownish, $\frac{1}{6}$–$\frac{1}{5}$ mm. in diameter; hyphæ very fine and delicate; branches hyaline, involved in a yellowish mucus; the spore terminal on slender branchlets. Spores hyaline, guttulate, multiseptate (15–20), coiled about twice; the spiral 14–18 mic. in diameter; the threads about 2.5 mic. in thickness. (Fig. 20.)

Growing on old leaves of *Sorghum nutans*, Newfield, N. J., *Mr. J. B. Ellis*. In the old specimen, at this time, the spores at first seemed a mere hyaline sack, but, after soaking awhile, the spiral arrangement became visible.

Genus V.—Troposporium, Harkness.

Sporodochium superficial, verruciform, farinaceous: hyphæ long, slender, flexuous, branched, the spores borne at the

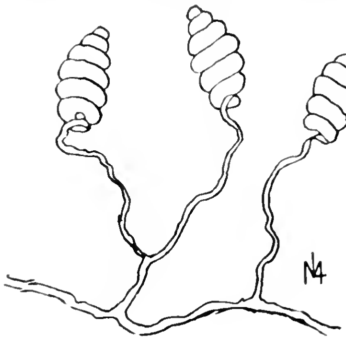


Fig. 21. Troposporium album.

apex of slender branchlets. Spores spirally coiled into an elongated ellipsoidal body. The spores are like those of Helicoön.

1. Troposporium album, Hark. Sporodochium white, verruciform, thick, often confluent; hyphæ slender, flexuous, branched, hyaline, the spores borne at the ends of slender branchlets. Spores hyaline, oblong-ellipsoidal, composed of 3–7 spires, closely coiled; spore 40–45x18–22 mic.; the thread about 7 mic. in thickness, continuous. (Fig. 21.)

Growing on dead stems of *Corylus rostrata;* California, *Harkness*.

The stroma consists of numerous granules and oil globules, which are set free by breaking.

PHOTOGRAPHING CERTAIN NATURAL OBJECTS WITHOUT A CAMERA.

By W. A. Kellerman, Ph. D.
Prof. Botany, Ohio State University.

Read at meeting of the Ohio Academy of Sciences, Dec. 30, 1891.

The objects referred to in the title of this note are those which are transparent or translucent, more particularly, ordinary foliage leaves, and other botanical specimens, wings of certain insects, fins of fishes, etc. The process consists in using the object itself as the negative and printing from it in the photographer's printing frame, in the ordinary manner.

The subject was first brought to notice by V. Fayod, in *Malpighia*, Anno III., fasc. iii.–iv., 1889, p. 120, under the title, "Note sur une nouvelle application de la Photographie en botanique," accompanied with a plate illustrating results obtained.

In the above-mentioned article, the details of the method are given, which have, in general, been followed in preparing the numerous specimens here placed before you. I have experimented briefly, but with a variety of objects, and have brought both poor and good photographs, in order that you might see the necessity of heeding certain precautions to insure success.

The majority of foliage leaves can be used, if it is desired to secure exact reproductions of their patterns of venation. Of many orders, such as Rosaceæ, Leguminosæ, Passifloraceæ, Urticaceæ, Gramineæ, most of the leaves have veins sufficiently translucent to admit of their being used as negatives, without any preliminary preparation—even previous pressing and drying not being necessary.

But in case of many leaves of the orders Compositæ, Ericaceæ, Umbelliferæ, Chenopodiaceæ, etc., they must be subjected to a process of bleaching in alcohol, followed by immersion in hot potassic hydrate; this is to be followed by thorough washing in pure and finally acidulated water, and

pressing the leaves till dry between sheets of bibulous paper. Such prepared leaves will give pictures in which the veins and veinlets are dark and the remainder of the leaf light colored, just the reverse of the photographs obtained by using the fresh or dried leaves without further preparation. In either case the venation — even in minutiæ — will be well shown.

Sometimes young leaves, in other cases fully matured leaves, give the best results. Leaves from the herbarium can be used at will. If the veins or petiole are very much thicker than the remainder of the leaf, they can be shaved down. Other specimens may, in some cases, need trimming.

It is necessary that the leaf (or other object) to be photographed be brought into *very close contact* with the sensitized paper, for, otherwise, all parts of the print will not be perfectly distinct. For this reason, the under side of the leaf — where, as a rule, the veins are more prominent — should be placed next to the clear glass in the printing frame, and the upper surface next to the sensitized paper. A layer of cotton or soft blotting paper can be placed over the back of the sensitized paper, which will insure closer contact with all parts of an object that may be somewhat uneven.

The time of exposure in bright sunlight will vary from a minute or two (for transparent wings), to fifteen or twenty minutes (for foliage leaves)—depending, of course, on the degree of transparency or translucency of the object. The print can be inspected from time to time and the proper density of the picture secured.

After exposure the prints can be fixed in a solution of hyposulphite of soda. Or if handsome photographs are desired, they can be toned in the gold solution commonly used by photographers, and fixed in the usual manner.

The process is so simple, comparatively inexpensive, some interesting results obtainable, and besides, many of the prints would prove useful in a variety of ways to botanists, entomologists and others. It is, therefore, believed that the reward will be fully commensurate with the time and energy expended.

VARIATIONS AND INTERMEDIATE FORMS OF CERTAIN ASTERS.

BY W. C. WERNER.

Assistant in Botany, Ohio State University.

Read at the meeting for the formation of the Ohio Academy of Science, December 30, 1891.

Of our native flowering plants the asters are among the most difficult for the systematist to dispose of. This is quite discouraging to the amateur botanist who wishes to study the genus. Color can not be depended on; every character laid down in the books is more or less inconstant. This is especially noticeable in the section *Heterophylli*, the subject of this paper.

In Gray's Manual, in the description of *Aster Shortii*, Hook., the words "naked petioles" are emphasized by italics, yet I find undoubted forms of this species with winged petioles.

Again I find *Aster undulatus*, L., meeting A. Shortii half way.

I can not draw a distinctive line between the outlying forms of the two species, which approach and apparently meet.

I find the same state of affairs existing between Aster undulatus and Aster cordifolius. When I came to Columbus, a year ago, the common blue aster in the immediate vicinity of the city was of considerable interest to me, for two reasons, viz: because of its polymorphic habit, and its persistence in evading every description of the books. Coming nearest to Aster sagittifolius, Willd., some of the extremely large-leaved and larger flowered forms I thought might be A. Lindleyanus.

The latter, however, is a strictly northern species; Labrador to Lake Superior, Saskatchewan, borders of British Columbia and New Hampshire is the range given in Gray's Manual and the Synoptical Flora. During October I looked for variations that might connect the ordinary form of A. sagittifolius with that answering to the description of A. Lindleyanus.

I sent a set of such as I obtained to Harvard University, labeling all A. sagittifolius, except the doubtful A. Lindleyanus. Mr. Sereno Watson said in reply:

"The specimens differ considerably. They are certainly part and probably all A. sagittifolius. * * * The most interesting plant of your collection is the A. Lindleyanus, T. and G., which, so far as I know, has not been reported south of the great lakes. * * * Aster Lindleyanus is unfortunately a rather indefinite thing, and seems to grade off imperceptibly into A. sagittifolius. Indeed, some of your specimens of A. sagittifolius, with large heads and loose involucre, may be regarded as more or less transitional."

Aster sagittifolius, as I find it in northern Ohio, is the most constant in general aspect and characteristic details of any of this section of Asters. The plants invariably live up to the typical characters, such as erect and rigid stems, inflorescence closely paniculate, and scales of the involucre linear with long attenuate tips.

The Columbus plants that we must under present arrangements refer to, A. sagittifolius, are just the opposite of this. I have thus far been able to detect but one character that appears at all constant. This is the late flowering of the larger forms approaching the description of A. Lindleyanus. I found one specimen having the erect stem and in a modified way the inflorescence of the northern Ohio form, thus showing affinity to what may be considered the type of the species.

Referring to the Columbus plants, A. sagittifolius, I spoke of their polymorphic habits. Taking as a type the smaller-leaved, loosely-flowered form (which is the one commonly met with), I find three distinct lines of variation. 1st. Into A. Lindleyanus; 2d, toward the northern Ohio plants, and 3d, connecting with cordifolius. In the light of my present knowledge of this Aster I do not think it worthy of specific rank, yet it seems to have good varietal characters. It is probable that the ranges of the typical plants of northern and the central Ohio forms meet and overlap.

We all know that among a lot of seedlings, the progeny of one plant will show many slight differences. In some cases these individual differences will be well marked. When such is the case, and when the characters are constant, but yet

connected with the typical form, we speak of them as varieties; we not only find this variation within the species, but the outlying varieties of too closely allied species often present variations approaching each other, until it is impossible to draw a clear line of demarcation.

Variation within the species, and not taking on any of the characters of other species, is well represented in the set of Aster cordifolius from Georgesville, near Columbus.

Two closely allied species, approaching each other through variations, is illustrated by specimens intermediate between Aster Shortii and A. undulatus, between A. undulatus and A. cordifolius, and between A. sagittfolius and A. Lindleyanus.

Again, variation may be due to hybridity. In a certain field, near Painesville, Ohio, A. undulatus and A. sagittifolius grow together. I found one specimen intermediate between the two species; it has the erect rigid growth of A. sagittifolius, the close, hoary pubescence of A. undulatus, with leaf characters tending that way, and involucre intermediate between the two. Forms of A. cordifolius partaking of characters of A. sagittifolius may be due to cross fertilization. A lanceolate leaved form found with A. cordifolius suggests hybridization.

In many genera the species have quite permanent characters, and are easy of determination. In those of wide variation, and when the differences blend into each other, we can not always say that a certain specimen belongs to either one of the two species, but must of necessity speak of it as intermediate between the two. Plants presenting these variations are too often disregarded by collectors. Indeed, some botanists are inclined to look upon these intermediate forms with displeasure, preserving as specimens only those that serve as types to specific descriptions. It is just these intermediate and puzzling forms that ought to be the most interesting, as showing the gradations of connections between closely allied species. Instead of bewildering the systematist, they aid him in unraveling the snarl of intermingling characters.

THE JOURNAL

OF THE

Cincinnati Society of Natural History.

VOL. XV. · CINCINNATI, JULY, 1892 · NO. 2.

PROCEEDINGS.

ANNUAL MEETING, April 5, 1892.

President Abert in the chair.

The minutes of the previous meeting were read and approved.

Mr. J. Ralston Skinner made a few appropriate remarks upon the death of A. J. Howe, and upon his motion the Chair appointed a committee, consisting of Geo. W. Harper, Charles Dury and Davis L. James, to take proper action regarding the same.

The annual reports of the Secretary of the Society, the Director of the Museum, and the Curator of the Photographic Section were read by the Secretary *pro tem.*, and upon motion were ordered received and filed.

Mr. Davis L. James then read the report of the Treasurer of the Society, and that of the Trustees. These reports were received and ordered filed.

Mr. J. Ralston Skinner then made a brief address, in which he congratulated the Society upon its financial condition, and urged a continuance of the same economic policy during the year to come.

Mr. T. H. Kelley moved a vote of thanks to the Trustees for the faithful and skillful manner with which the funds of the Society in their hands had been managed during the past year.

Mr. R. A. Holden moved that a committee of three be appointed by the Chair to audit the accounts of the Treasurer, and to examine the securities held by the Trustees of the Society. Carried.

The President appointed Messrs. Kelley, Bullock and Collier.

President Abert then delivered his annual address to the Society, and upon its conclusion, Mr. Davis L. James moved that the President appoint tellers of election, and that the Society proceed to the election of officers for the ensuing year. Carried.

The President appointed Messrs. Dury, Shipley and Andrew as tellers.

The Chair then called for nominations for the officers of the Executive Board, and the following names were proposed.

For President, T. B. Collier.
For First Vice-President, F. W. Langdon.
For Second Vice-President, B. M. Ricketts.
For Treasurer, Davis L. James.
For Secretary, T. H. Kelley.

There being no other candidates for the above offices, the Secretary *pro tem.* was instructed, upon motion of Mr. Dury, to cast the ballot of the Society for the gentlemen named for the respective offices, which was done, and they were declared duly elected.

Nominations for four members of the Executive Board at large being next in order, the following names were proposed:

Mr. Charles Dury, Mr. R. A. Holden, Jr., Dr. O. D. Norton, Prof. G. W. Harper and Col. J. W. Abert. The ensuing vote resulted in the following gentlemen receiving the highest number of ballots, and they were declared elected:

Mr. Charles Dury, Mr. R. A. Holden, Jr., Dr. O. D. Norton and Prof. G. W. Harper.

Mr. A. A. Ferris was nominated for a Trustee of the Society, and Dr. M. Cassatt for Librarian. There being no opposition, the Secretary *pro tem.* was instructed to cast the ballot of the Society for the gentlemen, which he did, and they were declared duly elected.

Nominations were next called for to fill the various Curatorships. The following named gentlemen were proposed:

For Curator of Geology, E. O. Ulrich.
For Curator of Botany, Davis L. James.
For Curator of Zoology, Charles Dury.
For Curator of Anthropology, Dr. O. D. Norton.
For Curator of Photography, T. B. Collier.
For Curator of Microscopy, B. M. Ricketts.
For Curator of Physics, J. D. Hurtig.
For Curator of Chemistry, Dr. Arch. Carson.

There being no opposition, the Secretary *pro tem.* was instructed to cast the ballot of the Society for these gentlemen, which he did, and they were declared duly elected.

REGULAR MEETING, May 3, 1892.

President T. B. Collier in the chair.

The minutes of the last meeting were read and approved.

The following candidates for membership were proposed, and their names ordered laid before the Society for the usual period, to-wit:

Walter H. Maxwell, Harry J. Mills, E. W. Weaver, William Sampson, Edward L. Reynolds and Clark W. Davis.

The report of the committee to audit the report of the Treasurer was read, and, upon motion, was received and filed.

A list of resignations was read, and, upon motion, the matter of their acceptance was laid over.

The resignation of W. P. Anderson, as one of the Trustees of the Society, was read and accepted. The election of his successor was laid over until the June meeting, and the Secretary was instructed to give notice of the election of his successor at that meeting.

Mr. Davis L. James recommended the election of Wm. H. Knight, of Los Angeles, Cal., as a corresponding member. Upon motion of Mr. Fisher, he way duly elected such corresponding member.

A communication from Amos W. Butler, of Brookville, Ind., inviting the Society to attend the annual meeting of the

Indiana Academy of Science, at Richmond, on May 12 and 13. Upon motion of Prof. Harper, the invitation was accepted with thanks, and the Secretary instructed to acknowledge same.

Mr. Dury, on behalf of the committee appointed to draft a memorial on Dr. A. J. Howe, submitted a report, which was received, and referred to the Publication Committee.

Mr. Davis L. James, on behalf of the Publication Committee, read the following papers by title, to-wit:

North American Helicosporae, by A. P. Morgan.

Variations of Intermediate Forms of Certain Asters, by W. C. Werner.

Photographing Natural History Objects Without a Camera, by W. A. Kellerman.

And were, upon motion, referred to the Publishing Committee.

Mr. Charles Dury reported to the Society a new species of slug (Limax maximus) brought to this country from Germany.

Col. J. W. Abert being called upon, gave an interesting talk upon artistic topics, discussing in order some strange features of perspective-reflection in the water, and a comparison of the work of Guido and Raphael.

REGULAR MEETING, June 7, 1892.

President T. B. Collier in the chair.

Minutes of last meeting read and approved.

Those gentlemen whose applications were recorded at the last meeting were duly elected.

Dr. P. M. Bigney was nominated by Prof. G. W. Harper for Trustee. Upon motion of Mr. Dury, the Secretary was instructed to cast the ballot of the Society for Dr. Bigney, which he did, and the gentleman was declared duly elected.

The President called attention to the deaths of Dr. R. M. Byrnes and Mr. Joseph Green. Upon motion, the Chair appointed the following committees:

Upon death of Dr. Byrnes — J. Ralston Skinner, Dr. O. D. Norton and Prof. G. W. Harper.

Upon death of Mr. Green — T. H. Kelley, E. J. Carpenter and R. D. Jones.

The following papers were read by title, to-wit:

The Preservation of Plants as Fossils, by Joseph F. James.

Manual of the Paleontology of the Cincinnati Group, Part III, by Joseph F. James.

Upon motion, they were referred to the Publishing Committee.

Mr. Dury reported still further about the imported German slug (Limax maximus) and displayed specimens of same.

A general discussion followed upon imported pests.

REPORTS PRESENTED AT THE ANNUAL MEETING.

REPORT OF THE TREASURER OF THE CINCINNATI SOCIETY OF NATURAL HISTORY, FOR THE YEAR ENDING APRIL 5, 1892.

SUMMARY.

Balance on hand, April, 1891,	$357 15
Total receipts from all sources,	3,495 93
	$3,853 08
Expenditures,	3,182 30
Balance,	$670 78

RECEIPTS.

Balance on hand last report,	$357 15
Dues and Initiations,	980 32
Interest,	2,491 11
Journal, sold copies,	24 50
	$3,853 08

EXPENDITURES.

Salaries and Wages,	$1,075 00
House expenses, including postages and sundries for Custodian and Janitor,	207 61
Printing notices and stationery,	89 25
Journal,	374 75
Gas bills,	29 24
Repairs,	98 57
Bonds cancelled,	900 00
Interest paid,	159 32
Fuel,	119 00
Binding, Library account,	62 60
Museum expenses (Taxidermy, removing Mohr Collection, etc.),	66 96
	$3,182 30

The total receipts from ordinary sources, including dues, sales of Journal, and interest on endowment funds, have been $96.06 less than the preceding year. This difference is owing to the smaller amount of annual dues paid in. This amounted

to about $300.00, and is due to the fact that in the previous year a large amount of back dues was collected.

The Treasurer has, by order of the Executive Board, paid nine of the six per cent bonds issued by resolution of February 17, 1891, leaving yet outstanding three of this series, and eighteen of the five per cent series, or twenty-one hundred dollars ($2,100) in all. The interest charges on these notes amounts to $108.00 a year.

The vouchers, orders and bills for items of expenditure will be presented to the Auditing Committee, together with a list of the same.

The interest on the endowment funds has been in most cases promptly paid.

All of which is respectfully submitted,

DAVIS L. JAMES,

Cincinnati, April 5, 1892. *Treasurer.*

The undersigned committee, appointed to audit the report of the Treasurer, beg leave to report that it has carefully examined the bills and vouchers submitted by the Treasurer with his report, and find that the same are in all respects correct. Respectfully submitted,

T. B. COLLIER,

T. H. KELLEY,

Cincinnati, April 20, 1892. *Auditing Committee.*

TRUSTEES' REPORT.

TO THE BOARD OF DIRECTORS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

Gentlemen — The undersigned Trustees of the Society beg leave to submit their annual report, showing the funds of the Society invested as follows:

MORTGAGES ON REAL ESTATE.

FROM.	Date.	Time.	Interest.		Par Value
Martin Byrnes, ...	April 12, 1887,	1 year,	6	per cent,	$4,000 00
W. S. Baker, ...	May 9, 1888,	3 years,	7	"	1,500 00
Caroline Blymyer et al,	Nov. 23, 1887,	2 "	6½	"	8,000 00
Anthony Costello, . . .	Sept. 19, 1887,	3 "	6	"	1,000 00

From.	Date.	Time.	Interest.	Par Value
Mary S. Orange,	Dec. 23, 1880,	3 years,	6 per cent,	2,000 00
Richard Oliver,	Aug. 18, 1887,	3 "	6 "	3,000 00
John A. Bigelow,	Aug. 31, 1889,	2 "	6 "	1,000 00
Joseph M. Story,	Nov. 30, 1889,	3 "	6 "	1,000 00
Margaret A. Shields,	Dec. 3, 1889,	3 "	6 "	4,000 00
Henry Snow,	Dec. 12, 1891,	3 "	6 "	2,000 00
Alwin Knop,	Jan. 18, 1892,	4 "	6 "	6,000 00
Hester V. Froome et al	Mar. 16, 1892,	5 "	6 "	3,000 00
Total,				$36,500 00

BONDS AND NOTES.

Cincinnati Southern 7-30 bonds,	$2,000 00
One Cincinnati deficiency bond (1901), 4 per cent,	530 00
One Cincinnati deficiency bond (1905), 4 per cent,	100 00
Note of A. A. Ferris, July 26, 1890, on demand, 6 per cent,	600 00
Cash on hand,	1,500 00
Total,	$4,700 00

RECAPITULATION.

Real estate mortgages,	$36,500 00
Bonds, notes and cash	4,700 00
Total,	$41,200 00

Since our last report both loans made to William M. Este have been paid, aggregating $12,500.00. This amount has all been re-invested except $1,500.00, which are still awaiting a favorable investment. The re-invested funds are represented by the mortgages to Snow, Knop and Froome. In all of the loans made during the past year, the Trustees have stipulated and required that the principal of the loan should be payable in gold dollars, and the three last-named loans are made payable in that form. The interest notes are payable in the current funds. It was thought advisable to require payment of principal in gold to guard against any tampering with the money of the country, and to avoid any substantial change in the value of the dollar by any legislation that might take place in Congress. The Trustees request that a committee be appointed to examine the securities of the Society, as set forth in the foregoing report.

Respectfully submitted,

Aaron A. Ferris, *Trustee.*

Cincinnati, April 5, 1892.

REPORT OF DIRECTOR OF MUSEUM.

CINCINNATI, April 4, 1892.

TO THE PRESIDENT AND MEMBERS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

As the Director of the Museum of the Society, I have to report that the collections are in a good state of preservation, having been carefully looked after, and the perishable specimens well disinfected and poisoned. The alcoholic specimens are also in good condition.

During the past year the Paul Mohr Collection has been transferred to our Museum, and the most attractive portion is now on exhibition in the third story of the new addition.

A fine collection of East India corals and shells, costing $400.00, has been donated to the Society, principally through the efforts of Robert Clarke, Esq. This collection is also displayed in the new room alluded to above.

In order to add more light for the proper exhibition of the articles on the fourth floor of the old building — principally Osteological specimens — a sky-light should be placed in the roof. This would also give more light to the stairway.

Our building is very dark and old, and not at all suited to the proper display of natural history specimens; and it does not seem as though it could be put in better condition, being so illy-adapted for the purpose — except at a large outlay of money. The better thing to do is to secure a lot and a new building at as early a day as possible, and in view of this it would be very unwise to spend any money on the old building, or to buy temporary cases for the specimens, as has been proposed. The only improvement or outlay I would suggest is the sky-light before mentioned. This is really necessary for the proper lighting of the fourth floor, since the back windows have been closed by the new addition.

The attendance of the public at the Museum has been greater than ever before — being more than six persons a day during the entire year.

There have been a number of other donations during the year, which have been noticed in the Journal of the Society. Among these is the Shafer Collection of shells and fossils, donated by the Cuvier Club, but not yet put on exhibition, owing to a lack of cases suitable for the purpose.

I would also suggest, in the way of permanent improvements for the building, that the front steps should be re-set, and the front pavement raised and levelled. There should also be a sidewalk elevator put in the cellar, for the purpose of raising ashes and other heavy matter.

Respectfully submitted,

J. A. HENSHALL.

REPORT OF THE SECRETARY.

CINCINNATI, April 5, 1892.

TO THE PRESIDENT AND MEMBERS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

In accordance with the requirements of the Constitution, I have the honor to submit the following report:

During the past year seven regular meetings of the Society have been held.

Twelve papers have been read in full, by abstract or by title, most of which have been published in the Journal of the Society.

Twenty-three active members have been elected during the year, and twenty-four members have resigned. One active member and one life member have died.

Since my last report I have collected and paid over to the Treasurer the following amounts:

Dues from Members,	$980 22
Subscription and sale of Journal,	24 50
Total,	$1,004 82

And donation to chair fund $10.00, paid to T. H. Kelley, Esq.

Our list of exchanges has been increased by the addition of the publications of the following societies:

Natural Hist. Soc. of Trentschin, Trentschin, Hungary.
Royal Soc. of South Australia, Adelaide, So. Australia.
State Historical Soc. of Wisconsin, Madison, Wis.
Societie Vaudoise des Sciences Naturelles, Lausanne.
Argentine Society of Nat. History, La Plata, Buenos Ayres.

The library of the Society has received one hundred and sixty-two volumes and parts of volumes, mostly pamphlets, by donation and exchange. Seventy-seven volumes have been bound during the year.

Over eighteen hundred persons have visited the Museum of the Society since April last.

The Eleventh Annual Course of Free Popular Scientific Lectures was given during January, February and March, in our new auditorium, with a very satisfactory attendance. The lecturers were Gen. B. R. Cowen, Dr. Thos. M. Stewart, Prof. Chas. A. Harper, Dr. M. H. Fletcher, Dr. A. N. Ellis, Prof. Thos. French, Jr., Col. Latham Anderson, Dr. A. B. Thrasher, Dr. William Carson and Mr. E. H. Wells, who all gave their services gratuitously, and are certainly entitled to the thanks of the Society.

The entire expense of course was only $18.75.

Respectfully submitted,

J. A. Henshall.

REPORT OF CURATOR OF THE PHOTOGRAPHIC SECTION.

Mr. President and Members of the Cincinnati Society of Natural History:

On behalf of the Photographic Section, I have to report an undiminished interest in all matters pertaining to Photography.

Our membership is now 113.

We have lost during the past year by death, none.

By removal from the city, two.

And by resignation, nine.

And have dropped from membership, for non-payment of dues, 31.

While we have gained ten new members.

In accordance with the custom inaugurated some years since, our Annual Outing was given on May 30th last (Decoration Day), and was attended by more than one hundred members of this Section and their friends. The place selected was Foster's Crossing, on the Little Miami R. R., a very beautiful spot, and convenient of access. In addition to the Annual Outing, a number of Saturday afternoon excursions were planned, carried into execution during the past Summer by a limited number of our members, and proved a most enjoyable relaxation from the cares of business and professional life.

Our Annual Print Exhibition was given in the studio of E. H. Barton, in this city, and an exhibition of photographs made by members of this Society was one of the features of the fair held at Carthage, Ohio, last Fall, under the auspices of the Humane Society. Our Annual Lantern Slide Exhibition was given on the evening of March 25th last, at the Odeon, and although hardly up to the standard of some of our previous exhibitions, it called out an audience which, in point of numbers and intelligence, far exceeded that of any former exhibition, clearly indicating that the public have not lost their interest in this kind of an entertainment. The Semimonthly exhibitions given by the Photographic Section in this hall, have been unusually well attended, both by members of the Natural History Society and by the general public.

This Section has spent a large amount of money in fitting up its reception and operating rooms, in the former of which may be found publications from all parts of this country and from Europe relating to matters photographic, while in the latter we have the most improved apparatus known to the profession, where every convenience is provided for amateurs to become proficient in the use of the camera by the practice of in-door photography. The only drawback to the complete enjoyment of the quarters we occupy has been the untidy and neglected condition of our operating room, which has been due, perhaps, as much to the financial policy of the Society, which has been too economic, as to any other cause, and which has been the ground of serious complaint on the part of our members. This Section, embracing, as it does, a very large proportion of the members of the Society, feel very much dissatisfied at the manner in which their department has been neglected, and are unanimous in their demand for a radical change in this regard during the coming year. I would very respectfully recommend to the incoming board, that special attention be given to the care of the rooms occupied by the Photographic Section, especially as their meeting room is the only apartment in this building which can be used as a reception or waiting room by the members of the Society and visitors.

Very respectfully submitted,

T. B. Collier,

Cincinnati, April 5, 1892. *Curator.*

R. M. Byrnes

MEMOIR OF DR. RICHARD M. BYRNES.*

This brief notice of one who occupied a prominent place in the Cincinnati Society of Natural History for so many years, and contributed so materially to its establishment and prosperity, and was so well loved and highly esteemed by all the members, is a simple token for the records of the Society.

Richard Mahan Byrnes was born at Pittsburg, Pennsylvania, on the 2d day of November, 1835. He received a moderate education in his youth, and when quite young came to Cincinnati and entered a jewelry store as a clerk, where he afterward became the traveling salesman and most trusted employe of Garrett T. Dorland, the jeweler, then at the corner of Main and Pearl streets. While so employed he studied mineralogy, and when an opportunity was afforded, in his travels, he collected minerals, and gradually became a general collector and student of Natural History. He also studied medicine and attended the Ohio Medical College, where he graduated in the Spring of 1863. He passed the examination for assistant surgeon in the army, but was not called into service. He had a mind for investigation and accurate observation and carried his studies, unaided, through all branches of nature and nature's productions, until he had made a thorough scholar of himself when he graduated in medicine, notwithstanding he had snatched the opportunities from the busy life of a clerk and salesman. The energy and taste thus displayed is an example which entitles him to the remembrance of all naturalists who desire the spread of learning and diffusion of knowledge among the people, for it shows that all intelligent men, whatever their station or position, may become educated or remain in ignorance of everything surrounding them, that is worth knowing, as their tastes and judgment may determine.

Soon after he graduated, he located at Middletown, Ohio, to practice his profession, but he only remained there two years,

*Submitted by committee appointed on death of Dr. R. M. Byrnes, as part of their report.

because he thought a better opportunity to accumulate this world's goods was thrown open to him; but here was a fatal mistake. He formed a partnership with H. H. Hill, in the wholesale and retail drug business, at the corner of Fifth and Race streets, and invested all he had. Drugs were very high at that time, but they soon began to decline in value, and their stock was of such a character that heavy losses ensued, and, notwithstanding the faithful attention to business for fifteen ensuing years, the losses were never overcome, and when the partnership was dissolved and the business closed he was a much poorer man than when he entered the business. During all this time, however, he had not neglected the study of natural science, which was in such perfect harmony with his pleasant and mild temperament. He had become an analytical chemist, as well as a druggist, an analytical mineralogist, and an expert in determining the value of ores; he collected and published a catalogue of all the fresh water and land shells of Ohio, and as a scientific botanist he catalogued all the plants indigenous to this part of the State, except the mosses and fungi, as well as being proficient in the medicinal virtues of all known to the pharmacopœia. He had become a geologist and a palæontologist, and managed to make a very large and valuable collection of fossils. It is difficult to conceive a career within the bounds of natural history more versatile and at the same time more accurate in details than that which marked the course and pursuits of Dr. R. M. Byrnes, as all will testify who ever had occasion to call upon him for information, in any of the various branches in which he was so proficient.

He was at the head of the movement for the establishment of the Society of Natural History, and if any one can be said to be its father it was Dr. R. M. Byrnes. He attended all the preliminary meetings, and kept the book for the signatures of those who would take part in founding the institution and securing its incorporation. He specially solicited signatures from among those whom he thought from their learning and habits would be of value to the institution, and no one did more in this regard than he, though Ludlow Apjones and two or three others were active participants, in the beginning, in establishing the Society. When the Department of Min-

eralogy was established, in 1871, he was elected Curator, which position he continued to hold by the annual re-elections until April, 1880, when he was elected President of the Society. He was twice re-elected President, thus filling the office for three consecutive years, after which he was elected a member at large of the Executive Board. He was a regular attendant at the meetings of the Society and a frequent visitor at the rooms, and spent a great deal of time in cleaning and arranging the various collections. He made an excellent presiding officer, and was always commended for his sincerity and fairness in all the matters that came before the meetings, and as the minutes will show, he was always in the chair to fill the position and perform the duties for which he was elected.

He was one of the founders of the College of Pharmacy, with which he was officially connected in some capacity for more than twenty years. He was appointed by the Court of Common Pleas a member of the examining board for two successive terms, and he served as trustee for ten years, beside serving on the Lecture Committee, and being President of the College.

He was appointed a special assistant on the Geological Survey of Ohio, as will be seen on the title page and in the preface to Volume IV, to prepare an article on the Mollusks of the State. He did the work, but it was never printed, as the second volume on zoology and botany never appeared.

He was an all-around naturalist; honest, generous, kind and beloved by all who knew him; and when the fabric of his life is unfolded, it will be found free from spot or blemish, a model of even workmanship, valuable and lasting in all its parts and beneficial, not only to contemporary students, but to those who shall examine it for a long time to come.

He resumed the practice of medicine in this city in 1881, in which service he continued until the approach of his untimely death. La Grippe and partial paralysis struck him down two years ago, from the effects of which he never entirely recovered. In March last he went to Eldridge, Iowa, hoping the trip might benefit him, but his health gradually failed and he expired, at that place, on the 28th day of May, at the age of 56 years. His body was interred here at Spring Grove Cemetery.

On the 8th day of August, 1860, he married, at Pittsburg, Pa., Elizabeth A. Ewing, a very estimable lady, who survives him, with four sons, to mourn the loss of an affectionate husband and father, and in whose grief the members of this Society deeply sympathize and offer this testimonial of their condolence.

S. A. M.

THE PRESERVATION OF PLANTS AS FOSSILS.

By Joseph F. James, M. Sc., F. G. S. A.

(Read by Title June 7, 1892.)

The subject of the preservation of plants in a fossil state is of great importance to all who look back into the past and try to ascertain the origin of our present flora. To some it matters little whether the primeval seas were filled with algæ or devoid of vegetable life; to some the species and genera which grew and absorbed the sunlight of long-ago Carboniferous times are matters of the utmost indifference. But whether of interest or not, no one can deny the value of those stores of coal which have resulted from the presence of plant life; which have given light and life to the world, and have made human existence possible in spots which otherwise would have remained desert wastes.

It is a peculiar trait of the human mind to be curious about subjects which come directly under its observation. To this trait, and to that other frequently abused characteristic — dissatisfaction, are to be ascribed many of the advances of the world. To the curious we owe the increase and perfection of our knowledge to the dissatisfied we are indebted for many improvements in our social and physical condition.

These curious folk who have delved in the bosom of the earth to gather some information relative to past conditions, have brought to light many facts of great interest. It is true we know but few of the details of the earth's history. That is one reason for the existence of that bane of the paleontologist — the imperfection of the geological record, to which constant reference is made when some hiatus becomes manifest. This being filled, it might round out some of our nearly completed theories. It might also serve to dissipate some of our crude but beloved hypotheses.

There are some statements of geologists which, although made inferentially, may be considered as having reached the stage of probability; others which may be considered certain-

ties; still others that are still highly problematical. Among the certainties may be placed that which asserts the origin of coal from forests of cryptogamous plants, in what is known as the Coal era; among the probabilities, that which says the early Cambrian and Silurian seas were filled with algæ; while among the highly problematical statements is that which asserts the preservation as fossils of much of the early algal vegetation.

When our early searchers began their investigations they frequently met with curious objects which bore no resemblance to animals, and which did not seem to be related in any way to ordinary plants. Finally, Adolphe Brongniart, in 1822, coined the genus *Fucoides*, into which he placed those fossil objects considered by him to be the remains of algæ.

It is not the intention here to enter into a disquisition on the genus *Fucoides*. That may be reserved for another occasion. It must suffice to say that the genus was eagerly accepted by the grateful students of geology, who forthwith proceeded to unload into it all the objects which were certainly not of animal origin, but which they thought must be the remains of some living thing of by-gone ages. The result of this was that before many years the genus began to overflow, and then, like an overloaded wagon, broke down. Originally designed as a receptacle for algæ, it soon contained an agglomeration of objects which bore no likeness to anything but themselves. Of late years this chaotic mass has been sifted out. Among the debris we find tracks of crustaceans, burrows of worms, trails of mollusks, marks made by trailing tentacles of medusæ, markings made by the tide or waves, rills made by running water, and holes formed by burrowing worms. The study of this mass of material has revealed the fact that those phenomena, which can be seen on the shores of our oceans, lakes and rivers to-day, were just as common in times past. We, therefore, seem justified in assuming that conditions prevailing now were in existence then.

The conditions governing the preservation of plants in a fossil state vary greatly. So, too, what may be termed the "expectation" of preservation varies. For example, a leaf or a branch falling to the ground and lying exposed to the elements is far less likely to be preserved than one which is protected from these destroying agencies. Also, a plant of a

hard, woody, vascular nature stands a better chance of being preserved than one of cellular structure; while one of a silicious nature, such as a diatom, has the best "expectation" of all three. There are certain requisites necessary to insure preservation of any plant. One of these is that it must be in a position to be almost immediately covered by some material. It may fall into the water, and sinking to the bottom of a lake, or swamp, or morass, be covered by mud or sand. Or it may lie on the sea shore and be covered by sand brought in with the tide; or finally, it may, through certain chemical properties it possesses, so act upon the stone upon which it lies as to be preserved, not in actual substance, but as an intaglio.

As now generally recognized, the plants of the Coal era grew upon the shore or in the waters of swamps or marshes situated upon or near the shores of the sea, so that the tides could enter, if not daily, at least at intervals. Oscillations of the land, an alternate rising and falling, allowed the sea ingress, and then was deposited a mass of sand or gravel which compressed the vegetable matter lying on the bottom, and under the pressure turned it into coal. In this way was preserved not only the outline, but the actual substance of the plant. This, however, is not always the case. Very frequently leaves occur in a fossil state which are impressions merely. The sandstone shows no traces of carbonaceous matter, but the outlines and the venation are as perfect as if the actual leaf were before us. In these instances the particles of organic matter have been replaced, particle by particle, by silica. This also occurs in those cases when branches or leaves are immersed in hot water, having silica in solution, as in certain geysers of the Yellowstone region. Here, when at times a tree stands near enough to a geyser to receive the water periodically thrown up, it will be found gradually transformed into stone, suffering a living death.

Perhaps the most remarkable method by which plants or their outlines may be preserved, is by what may be termed the chemical process. The possibility of this occurred to me one day last Fall, as I walked along the street in the rain, and looked at the fallen leaves on the pavements. I first noticed numerous irregular, discolored patches on the stone slabs. Looking more closely, I found that these discolorations had been caused by the leaves, which had left their impress on the

stone. In many cases this impression was so distinct that there was no difficulty in recognizing the species. The leaves were those of the soft maple, one or two species of oak, tulip tree and sycamore. There is here a possibility of the preservation of the remains of plants, or at all events of their impress upon stone, had it occurred under more favorable circumstances. But on a pavement, where people were passing constantly, the impressions were worn off and soon disappeared. The rain, however, did not seem to wash them away, so they were something more than mere surface markings.

This method of preservation of plants has been noticed as long ago as 1858, and in the Annals and Magazine of Natural History printed in that year,* Mr. Chas. Peach published a paper in which he speaks of the "Nature-printing" of seaweeds on the rocks of one of the Orkney Islands, off the coast of Scotland. The genera and species were easily recognizable from the impressions, these being of a yellowish color on a dark background. Some of the slabs of stone were two or three feet long and half as wide, lying from one-half to one-third way between tide marks. The stones were coated with an olive-brown seaweed, *Ralfsia verrucosa*, and Mr. Peach makes the following remarks in regard to it:

> "This coating may be likened to the chemical preparation in photography, the *Ralfsia* being the sensitive part to be eaten away by its overlying corrosive brother. The impress is thus made and the stone when washed by the next flowing tide is cleared of all the vegetable matter, both of the decaying *Desmarestia* and dissolved *Ralfsia*: the picture is then beautifully shown (fixed) on the light-yellow coated slab. Not only does the *Desmarestia* destroy the *Ralfsia*, it also dissolves some of the rock; and thus, as well as the depression left by the washing out of the alga, it is engraved in the stone; and probably this depression is added to, time after time, by the carbonic acid in the sea-water, and thus the more indelible it becomes."

The writer goes on to state that impressions of this sort are quite common in various geological formations, and concludes by expressing the belief that while some of the many problematical markings may have been produced by annelids and crustacea, most of them represent algal remains. While we can not agree with this conclusion, the observations of Mr. Peach are of great interest, as indicating a method of preservation of plant impressions which has not been generally noticed or commented upon.

*3d ser., vol. ii., pp. 50-54.

SOME NEW SPECIES AND NEW STRUCTURAL PARTS OF FOSSILS.

By S. A. Miller and Charles Faber.

(Read August 2, 1892.)

Modiolopsis corrugata, n. sp.

Plate I, Fig. 1, left side view, natural size.

Shell above medium size, oblong, widening behind the beaks, both on the cardinal and basal lines; height a little more than the thickness; truncated at an angle of nearly forty-five degrees in front of the beaks, and rounded into the basal margin; posterior end rounded. Basal margin very slightly contracted by a shallow undefined cincture that arises below and in front of the beak on each valve and extends obliquely to the basal margin. Somewhat winged on the cardinal line posterior to the middle of the shell. Beaks at the anterior end of the shell and extending quite beyond the hinge line. Umbones moderately large; umbonal ridge swelling in the middle of the shell and fading away toward the postero-basal margin. Surface marked by strong ribs, that originate on the hinge line and at an undefined depression above the umbonal ridge and curve backward and downward to the base, where they are most strongly defined. The posterior cardinal wing is ribbed in straight and also in slightly curving lines, directed upward and backward from the same undefined depression. A few obscure shallow concentric depressions are seen on some of the casts. The muscular impression is not deep or large, and it is located below and anterior to the beaks. External shell unknown.

This species is distinguished by the general form, and by the posterior cardinal wing, from *M. pholadiformis*, which the surface markings of the shell would, otherwise, seem to ally it. It need not be compared with any other defined species.

It is in the collections of both authors, but the type belongs to Mr. Faber. Found in the Hudson River Group, near the top of the hills, in Cincinnati.

Modiolopsis longa, n. sp.

Plate I, Fig. 2, left side view; Fig. 3, cardinal view, natural size.

Shell very long, gradually enlarging from the front to the posterior third, and even widening posterior to this: hinge line straight, basal margin nearly straight in the middle part of the shell; cardinal and basal lines gradually converge from near the posterior end to the beaks; height greater than the thickness; anterior and posterior ends rounded; a flattened area exists below and behind the beaks extending obliquely to the basal margin, but it does not produce any contraction of the basal margin. Beaks near the anterior end of the shell and extending beyond the cardinal line. Umbones quite small and umbonal ridge soon disappearing in the gradually increasing ventricose character of the valves behind the beaks. Muscular impressions small and very little below and anterior to the beaks. The casts at hand do not preserve any of the surface markings, though the casts are in a good state of preservation. External shell unknown.

This species is distinguished by its general elongated form, converging basal and cardinal lines, undefined umbones, and expanding and wedge-shaped posterior end. There is no defined species with which it can be confounded.

Found by Charles Faber, in the Hudson River Group, on the hills, at Cincinnati, and now in his collection.

Modiolopsis sulcata, n. sp.

Plate I, Fig. 4, left side view, natural size.

Shell about medium size, elongate, subelliptical in outline; height greater than thickness; both anterior and posterior ends rounded; cardinal line slightly arched behind the beaks; basal margin broadly and gently rounded. Basal margin very slightly contracted by a shallow undefined cincture, that arises

at the beak on each valve, and is directed obliquely downward and backward. Beaks at the anterior end of the shell and extending beyond the hinge line. Umbones of moderate size and umbonal ridge gradually enlarging until it passes the middle of each valve and then tapering to the postero-basal margin. Posterior end wedge shaped. Surface of each valve marked by a rather broad furrow that arises at the cardinal line behind the beaks and extends in an oblique line to the postero-basal margin, and above this, near the middle of the shell another furrow arises and extends to the posterior end of the shell, and above this within the posterior third of the shell another furrow arises and extends to near the postero-cardinal margin. Below the first described furrow, the shell is ribbed in slightly curving lines to the basal margin, where they are most strongly defined. A few obscure concentric lines are seen on the cast behind the commencement of the principal oblique furrow. The muscular impression and external shell unknown.

This species is distinguished by its subelliptical outline, and by three oblique furrows on each valve. This latter peculiarity we have never observed on any other species in this genus.

Found by Charles Faber, in the Hudson River Group, on the hills, at Cincinnati, and now in his collection.

Aviculopecten germanus, n. sp.

Plate I, Fig. 9, left valve, natural size.

Shell small, a little higher than long; inequilateral; oblique; base regularly rounded; antero-basal and postero-basal margins rounded. Hinge oblique, nearly straight, not quite equaling the greatest length of the valves below. Posterior ear extends to the lateral border, with which it forms nearly a right angle; it graduates into the shell below, without the presence of a sinus. Anterior ear rather shorter than the posterior one, angular at the extremity and rounding on the margin below into a notch, and arching from the wing into a deep and distinct sinus that separates it from the posterior margin of the shell. Umbo tumid and umbonal slopes diverging

to the margin. Beak high, pointed and projecting beyond the cardinal margin a little forward of the middle of the hinge line. There are two costæ on the posterior ear, and three or more finer ones on the anterior ear. There are about twelve principal radiating ribs on the body of the shell and about half as many rudimentary and intercalated shorter ribs between them; they are separated by wider flattened spaces. It is difficult to tell from our specimens whether or not there were any concentric lines, though they are quite well preserved; if there were such lines they were very fine.

This species approaches more nearly to *A. rectilaterarius* than to any other, but it may be readily distinguished by the scarcity of the radiating ribs and the wide flattened spaces between them; the beak, too, is higher and more pointed, as well as having a more tumid umbo.

Found in the Coal Measures on Elkhorn Creek, in Kentucky, and now in the collection of Mr. Faber.

Orthodesma mundum, n. sp.

Plate I, Fig. 11, left valve slightly broken at the posterior end; Fig. 12, cardinal view, natural size.

Species a little below the medium size. Shell elongate, more than twice as long as wide, thickness less than half the width. Cardinal and basal lines diverging at a slight angle posteriorly. Anterior end forward of the beaks very thin, contracted beneath the beaks, then somewhat extended and abruptly rounded to the basal margin. Posterior end broad, obliquely rounded and produced at the postero-basal angle, which is abruptly rounded into the base. Beaks anterior, small and produced beyond the cardinal line. Umbones compressed and flattened toward the basal margin and forming a ridge on each valve directed toward the postero-basal angle, above which they are depressed into a thin, wing-like expansion toward the postero-cardinal border. Surface marked with fine concentric lines.

This species can not be readily confounded with any other described form, and no comparison is, therefore, necessary.

Found in the Hudson River Group, near the top of the hills, at Cincinnati, and now in the collection of Mr. Faber.

PROTOSCOLEX MAGNUS, n. sp.

Plate I, Fig. 5, natural size; Fig. 6, magnified two diameters.

This species is larger than any defined by Mr. Ulrich, but otherwise very much like *P. ornatus.* His diagnosis of the genus is limited, and no idea of the character or substance of the shell is indicated, and, therefore, in attempting to describe this species there will necessarily be a commingling of generic and specific characters, to a certain extent.

The test is very thin and exceedingly fragile. If one could conceive of a crinoid column composed of very thin plates and possessed of a thin epidermal coating, which it could shed, and such coating could become fossilized and more or less compressed, it would be a very good ideal representation of the tests in this genus. Generally they are finely granular and black or brownish black, but, sometimes, they have a grayish color something like that of a crinoid, but without the crystalline structure. They are not any thicker than the coating of a Graptolite, and do not have the same shining black color or corneous texture. They occur in soft blue shale or semi-indurated mud.

As above remarked, they appear as compressed, elongate, cylindrical bodies, composed of very thin segments. In the species under consideration, the length of about ten segments will equal the greatest diameter of the body, in its compressed condition. Each segment is ornamented with a single row of six or eight papillæ. All specimens observed are curved more or less, and all taper a little toward one end. The length of the specimen, part of which only is illustrated, is one and three-fourths inches, and the larger end is not complete, and it is doubtful about the completeness of the smaller end.

That these bodies are not crinoid columns, in any state of mineralization, the following evidences are offered:

1. No crinoidal matter enters into the substance of the test.

2. We know of no crinoid columns, in any group of rocks, having undergone such destruction and mineralization as to leave only the representation of the extreme outer coating, in a fossil condition.

3. We know of no crinoid columns in the group of rocks,

in which these fossils occur, having such thin plates as the segments of these bodies represent.

4. The outer papillæ bearing covering of crinoids is the first to suffer destruction, and it is rare, in palæozoic rocks, to see this part represented in any state of preservation.

We have no evidence to offer to show that they represent the tubes of Annelida, but probably they do, and as we can not class them anywhere else, we leave them where others have placed them.

Found by Mr. Faber in rocks of the age of the Utica Slate, near low water mark, below Mowry's Foundry, in Cincinnati, and now in his collection.

Cyclocystoides cincinnatiensis, n. sp.

Plate I, Fig. 7, natural size; Fig. 8, magnified two diameters.

This species, so far as known, consists of a ring composed of thirty equal subcuneate plates, surrounded with a thin rim composed of minute granular plates. The plates of the ring are narrow and separated by rather wide furrows, the sharper edge being on the inner side of the ring; they show no surface ornamentation. The groove on the inner side of the ring can be seen distinctly, but the rest of the internal part is unknown. The outer rim is composed of such minute plates, that they can hardly be distinguished with an ordinary magnifier. The diameter of the specimen illustrated is about one-third of an inch, but the width of the rim is only about two-hundredths of an inch.

This species is distinguished from such species as *C. magnus* and *C. bellulus*, by the character and structure of the outer rim alone, and it will be distinguished from most other species by the shape of the plates in the ring, and, as we think the number of plates in the ring is of specific importance (and it is, so far as any learning and research has yet extended), that character will distinguish it from all heretofore described, as none have been defined having thirty plates. There is no described species with which it is necessary to make a comparison, for the purpose of distinguishing it.

Found in the Hudson River Group, near the top of the hills, in Cincinnati, and now in the collection of Mr. Faber.

CYCLOCYSTOIDES, sp.

Plate I, Fig. 13, fragment of superior side, showing part of the ring, the outer rim, having mammillary scars, and below and beyond this, plates from the other side; on the interior of the ring may be seen the commencement of the internal rays, and below this the plates belonging to the other side; Fig. 14, plates on the dorsal side of the same specimen; Fig. 15, the same magnified two diameters.

The ring is mineralized and cracked, so it does not show the plates, and, therefore, the species to which this fragment belongs can not be determined. Judging from the rim it belongs to *C. magnus*, or an allied species. The plates on the dorsal side, not only cover the internal disc, but they cover the dorsal side of the ring and rim and may be seen extending beyond even that. Probably, in a better preserved specimen, an outer rim of minute plates exists beyond the rim of mammillary elevations. The dorsal plates are so large that it is remarkable that they have remained unnoticed until this time.

Found in the Hudson River Group, on the hills, in Cincinnati, by Mr. Faber.

AGELACRINUS PILEUS?

Plate I, Fig. 10, the under side, showing part of the structure.

We suppose the specimen before us is the under side of *Agelacrinus pileus*, because of its depth, but it may be *A. cincinnatiensis*. Probaby the lower side of each is constructed substantially alike, as there is very little difference between their upper faces. We have no recollection of ever having read a description of the under side of any specimen, in this genus, except that given by Meek, in Ohio Pal., vol. 2, p. 55, as follows:

"The under side of each arm or ray is here seen to be composed of a single series of quadrangular pieces, that are not imbricating; while the disc plates near the outer margin show, on their inner surfaces, little parallel ridges, directed inward, and apparently fitting into corresponding furrows in the lapping edges of the contiguous pieces."

Our specimen must be much better preserved than his, as it shows much more than his did. The imbricating plates, of course, are simply the reverse of the opposite side. It is in the arms and central part that we note important structural discoveries. The under side of the rays, as seen from below, consist of a row of plates on each side of the furrow, which interlock at the bottom of the furrow, and are, therefore, without reference to abutting imbricating plates, pentagonal instead of quadrangular, as Meek described them. They extend beyond the margin of the imbricating plates into the visceral cavity, half the depth of the ambulacral furrows, and are separated from each other, in their extension laterally into the visceral cavity, so as to present a strongly serrated edge, as shown in the illustration. The furrows are covered with thin non-imbricating plates, that do not cover the serrated edges above described. Part of the covering is preserved in our specimen, as shown in the illustration, on two rays, but the plates are so small and the sutures so indistinct, that they could not be shown, except in a greatly magnified view. The coverings of the rays are united near the center of the fossil by a subpentagonal rim, that extends deeper into the visceral cavity than any part of the internal rays, and, we believe, extended to the very bottom of the test, and formed the part of the organism that adhered to the foreign object to which these animals attached. Three sides of this projecting rim are preserved and shown in the illustration, and the surface is flattened, as if for the purpose of attachment. Within this pentagonal rim there is a pit showing the five subovate mouths of the ambulacral canals, which are also indicated in the illustration.

This internal framework of Agelacrinus, we believe, has never before been illustrated or described. We regret that the side of the central pit, on which the anal opening is situated, and the internal part of that orifice, are destroyed in our specimen; for it would be very interesting to know whether or not the two were connected, and, if so, in what way.

The specimen illustrated was found near the top of the hills, in Cincinnati, in the Hudson River Group, and belongs to Mr. Faber.

HOLOCYSTITES AFFINIS, n. sp.

Plate I, Fig. 16, anterior side view; Fig. 17, posterior side view; Fig. 18, summit view.

Species medium size, sessile, subovate to subglobose, posterior and left side more tumid than the anterior and right side, and the most tumid part is below the middle. There are about seven ranges of plates of unequal size and a few intercalated ones. The mouth is large and a little anterior to the central part of the summit. Ambulacral orifice near the posterior central part of the summit, and surrounded with four prominent arm bases. All the plates are ornamented with large pustules, and pierced with numerous pores. There are a number of the large circular openings or pits irregularly distributed on various parts of the test, like those described on *H. elegans*, *H. rotundus* and *H. turbinatus*, the economy of which has not been ascertained, and which may represent only a diseased test.

It would seem to be most nearly related to such forms as *H. ornatissimus* and *H. subovatus*, but a comparison with the illustrations will show it is distinguished by its form and the location of the mouth and ambulacral orifice, as well as by the number of the plates and by the circular pits, if that character indicates a specific difference. These pits cross sutures and may embrace the angles of three or four plates, or they may be embraced wholly within a plate; when they cross a suture the suture seems to disappear and the plates at that place are anchylosed. This anchylosis and some of the rock which adheres to the specimen illustrated has prevented us from correctly outlining all the plates. The Holocystites are so variable in all respects that it is hard to tell exactly what should be considered specific characters and what should be regarded as variations among fossils belonging to the same species.

Found in the Niagara Group, near Madison, Indiana, and now in the collection of Mr. Faber.

MANUAL OF THE PALEONTOLOGY OF THE CINCINNATI GROUP.

By Joseph F. James, M. Sc., F. G. S. A.

Part III.

(Continued from Vol. xiv, p. 163.)

(Read by Title June 7, 1892.)

Sub-class Stromatoporoidea.

A group of Hydrozoa, with a calcareous and frequently large-sized "cœnosteum" or skeleton; varying in form from a spherical or irregular and sometimes branched mass, to a thin, flattened expansion; frequently attached to some foreign body by a single point, or by an epithecal membrane; exhibiting, more or less clearly, a series of concentric laminæ, separated by interlaminar spaces; the former arising from processes given off at certain definite points from rods or pillars running, either between two laminæ, or crossing several in succession; outer surface with numerous minute pores, or obtuse, imperforate projections.

The group is confined to Silurian and Devonian rocks, and is made by Nicholson to include the aberrant *Beatricea*, as well as the typical *Stromatopora*, (Man. of Pal., vol. 1, 1889, pp. 229–231). In the Cincinnati Group three genera are represented, the characters of which are given below.

Genus 1.—Stromatopora, Goldfuss, 1826.

Skeleton (cœnosteum) consisting of concentric, calcareous laminæ, separated by distinct interlaminar spaces, which are crossed by numerous radial pillars; radiating water canals and surface grooves sometimes present, and placed around minor centers; openings of large canals (oscula) also sometimes present; growing in irregular masses, sometimes with

a foreign body as a nucleus; spreading out into extended expansions, covered inferiorly by a thin, striated, calcareous epitheca, or else growing in thin layers parasitically upon foreign objects. (Goldfuss, Petrefac. Germ., 1826, p. 22; Nich. & Murie, Jour. Linn. Soc. Lond., Zool., vol. 14, 1877, p. 217).

Remarks.—First defined by Goldfuss in 1826, the above description is taken from Nicholson and Murie's Monograph of the Stromatoporoidea. Although it has been stated by one author that the genus does not occur in Lower Silurian rocks, there are certainly some species that with the present definition can be referred here with justice. The forms given below have been found in the Cincinnati Group.

Key to Species.

a. Free; hollow, tubular or cylindrical.

1. tubularis; outer surface without monticules.
2. subcylindrica; outer surface with prominent monticules.

b. Parasitic, incrusting shells, corals and other substances.

3. lichenoides; surface rugose; occasional large canals.
4. scabra; surface with prominent monticules.
5. papillata; surface granular, papillæ closely set.
6. ludlowensis; both free and parasitic; surface rough and with both minute pores and large oscula.

c. Massive.

7. hindei; surface with low, obscure monticules.
8. indianiensis; monticules very numerous and prominent.

1.—S. TUBULARIS, U. P. James, 1884.

Cylindrical or tubular, hollow, 2 to 2½ inches in diameter and 1 inch or more long; laminæ about $\frac{1}{20}$ inch thick, irregular, wavy, with serrate edges; interspaces thin; oscula at irregular intervals; central cavity of tube filled with broken shells, corals, or masses of clay, or sometimes entirely empty. (Jour. Cin. Soc. Nat. Hist., vol. 7, 1884, p. 139.)

Locality.—Cincinnati, Morrow and Lebanon, Ohio.

Remarks.—A curious and well-marked species, showing in weathered specimens the characteristic laminæ. Some speci-

mens still have the central cavity filled with foreign material, as in the original figured specimen, while in others this has entirely disappeared. The specimens are then circular, one in particular being napkin-like in shape, without any indication of its having been broken at either end.

2.—S. SUBCYLINDRICA, U. P. James, 1884.

Subcylindrical, hollow, sometimes compressed; exterior surface covered with prominent monticules, $\frac{1}{10}$ to $\frac{1}{20}$ of an inch high, irregularly distributed; apices and slopes of these with radiating lines or depressions, giving them a stellate aspect; spaces between the monticules covered with circular or elongate papillæ, $\frac{1}{20}$ of an inch apart; no surface pores; specimens curved, 2 to $2\frac{1}{2}$ inches long; internal structure irregularly porous. (Jour. Cin. Soc. Nat. Hist., vol. 7, 1884, p. 20). *Labechia montifera*, Ulrich, Contrib. to Am. Paleont., vol. 1, 1886, p. 33.

Locality.—Morrow and Clarksville, Ohio, and Madison, Indiana.

Remarks.—This species is readily distinguished from the previous one. Both are hollow, the interior cavity being filled with some foreign substance in each, but the outer surface is very different in having prominent monticules, the tops and sides of which have openings in them. *Labechia montifera*, referred to here as a synonym, was described in 1886. There are no features given for it which justify its separation as a distinct species.

3.—S. (?) LICHENOIDES, U. P. James, 1879.

Cœnosteum a thin expansion, irregular in outline, parasitic on corals; $\frac{1}{8}$ to $\frac{1}{2}$ inch in diameter, and $\frac{1}{4}$ to $\frac{1}{2}$ line or more thick; surface rugose or undulating, and with small, irregularly-shaped pores, with occasional larger, circular oscula-like openings; in some specimens larger and more irregularly-shaped pores are found about the margin. (The Paleontologist, No. 3, Jan. 15, 1879, p. 18).

Locality.—Cincinnati, Lebanon, Batavia, Blanchester, etc., O.

Remarks.—This species differs markedly from both the foregoing. It is a parasitic form, growing on various species of brachipoda and corals. The outer surface shows both large and small pores.

4.—S. SCABRA, U. P. James, 1879.

Cœnosteum a thin crust on foreign bodies, (shells or corals), one line or less thick, made up, apparently, of very thin laminæ; surface marked with prominent, conical or elongated monticules, ½ line to a line high, and from one to two lines apart; entire surface covered with closely set papillæ, generally with small, circular openings at the apex; varying in size from one to two inches square. (The Paleontologist, No. 3, Jan. 15, 1879, p. 18.)

Locality.—Cincinnati, Lebanon, Blanchester, etc., O.

Remarks.—Resembles the preceding, (*lichenoides*), in being parasitic, but differs in its prominent monticules, and the presence of papillæ between them. In this respect it resembles the species that follows, but that one is without any monticules.

5.—S. PAPILLATA, U. P. James, 1878.

Cœnosteum a thin crust on corals, shells, etc.; outer surface with small, closely set, prominent papillæ or tubercles, giving a granular appearance; papillæ with or without circular openings at the apices; 6 to 8 papillæ in one line, the interspaces non-poriferous. (The Paleontologist, No. 1, July 7, 1878, p. 1.)

Locality.—Cincinnati, Lebanon, Blanchester, etc., Ohio.

Remarks.—As noted in the remarks on the previous species, this one differs mainly in having no monticules.

6.—S. LUDLOWENSIS, U. P. James, 1884.

Cœnosteum varying in outline and in size; 4½ by 3 inches, and 2½ inches thick; sometimes parasitic, and then varying from $\frac{1}{10}$ to $\frac{3}{10}$ of an inch thick; laminæ irregular, undulating, from 4 to 6 in $\frac{1}{10}$ of an inch, including interspaces; transverse sections show numerous circular or oval oscula (?) irregularly

distributed; surface irregular and rough, showing numerous minute pores and a greater or less number of oscula. (Jour. Cin. Soc. Nat. Hist., vol. 7, 1884, p. 140.)

Locality.— Ludlow, Ky., etc.

Remarks.—This species occurs under both a parasitic and a free form. The presence of small pores and larger oscula at the surface, will serve to distinguish it from the others described.

7.—S. HINDEI, Nicholson, 1874.

There is a specimen of the present genus in the collection of the U. S. National Museum without a name which has many of the characters of *S. hindei.* It is massive, and only a fragment of a large specimen. The polished section does not show the large oscula said to be one of the characters of *S. hindei.* The laminæ are very sinuous, and close together, averaging about five to a line. A portion of the outer surface, which is still preserved, shows rounded monticules, not very prominent. A condensation of the original description of Dr. Nicholson is given below to serve for identifying the species, should it actually occur in the Cincinnati Group.

Fossil forming thin crusts, or hemispheric masses, composed of concentrically disposed strata, each made up of calcareous laminæ separated by interspaces; laminæ sometimes connected by transverse pillars, but more commonly bent and curved so as in inosculate, thus giving the whole a vesicular appearance; about 8 laminæ in one line; upper surface shows linear openings, and also large rounded or oval canals from a line to a line and one-half in diameter. (Ann. and Mag. Nat. Hist., 4th ser., vol. 13, 1874, p. 12.)

Locality.— Richmond, Ind.

Remarks.— *S. hindei* is stated by Nicholson to be from the Niagara group, and it is, of course, possible that the form under consideration is not that species.

8.— S. INDIANIENSIS, n. sp.

There is a second specimen of *Stromatopora* in the U. S. National Museum, also without a name. This is a massive species, about 8 inches long, 6 inches wide and 5 inches high. The monticules are very numerous and quite large and promi-

nent. The internal structure can not be ascertained, because of the presence of calcite in a crystallized form, but at one point the characteristic layers of *Stromatopora* can be observed. For this specimen the name *S. indianiensis* is proposed, inasmuch as it seems to be undescribed. In its prominent monticules it bears considerable resemblance to *S. tuberculata*, Nicholson, but that species is parasitic, while the present one is massive.

Locality.—Near Connersville, Indiana, in the upper layers of the Cincinnati Group, associated with *Beatrica nodulosa* and *Bellerophon bilobatus.* Collected by A. C. Benedict.

Genus 2.—STROMATOCERIUM, Hall, 1847.

Skeleton (cœnosteum) massive, composed of dense, thick, calcareous, horizontal and concentric laminæ, separated by narrow and irregular interspaces; laminæ irregularly disposed; no radial pillars crossing interlaminar spaces; entire mass perforated by vertical tubes without walls at short and irregular distances; the tubes place the interlaminar spaces in communication, but can not be said to run from top to bottom. (Hall, Pal. of N. Y., vol. 1, 1847, p. 48; emend., Nich. & Murie, Jour. Linn. Soc. Lond., Zoology, vol. 14, 1877, p. 222.)

Remarks.—The original description of this genus was very meager and unsatisfactory, and the emended one given by Nicholson and Murie, as above, is preferred. It is perhaps doubtful whether it occurs at Cincinnati. It is given, however, to serve as a means of identification in case it be found.

1.—S. CANADENSE, Nicholson & Murie, 1878.

Skeleton (cœnosteum) in the form of large, rounded or irregular masses, composed of numerous dense, concentric laminæ, about five of which, (including the interlaminar spaces), occupy one line; interlaminar spaces open, without radial pillars; the whole mass transversed by numerous discontinuous vertical canals, $\frac{1}{50}$ to $\frac{1}{80}$ of an inch or less in diameter. (Ibid., p. 223.)

Locality.— Peterborough, Ontario.

Remarks.— The fact that Hall's description of *S. rugosum* (Pal. of N. Y., vol. 1, 1847, p. 48) was so meager that the species could not be recognized by it, led to the coinage of the name above given. The two may and may not be the same.

Genus 3.— BEATRICEA, Billings, 1857.

Tree-like, nearly straight, cylindrical stems, from 1 to 14 inches in diameter, perforated by a cylindrical and nearly central tube, which is transversely septate; outside of tube composed of numerous concentric layers like those of an endogenous tree. (Rept. Prog. of Geol. Sur. of Canada, 1853-'54- 55-'56, 1857, p. 343.)

Remarks.— This strange genus has been the subject of considerable discussion, and its position in classification is still a matter of conjecture. It was originally described as a plant. Prof. Alpheus Hyatt examined a series of specimens, and then considered the genus more nearly allied to the Cephalopoda than any other group, and proposed a new order, (*Cerolites*) and a new family (*Ceriolidæ*) for its reception. (Am. Jour. Sci., 2d ser., vol. 39, 1865, p. 266). At a subsequent date this opinion was modified and he called it a large foraminifer, (Proc. Am. Asso. Adv. Sci., vol. 33, 1885, p. 492,) stating then that it was "neither a sponge, an ally of *Stromatopora*, a coral allied to *Cystiophyllum*, a cephalopod allied to *Endoceras*, nor a mollusk allied to the *Hippuritidæ*, as supposed by various authors." Nicholson considers its position still very uncertain, but he nevertheless puts it among the *Stromatoporoidea*. (Man. of Pal., vol. 1, 1889, p. 234.) S. A. Miller places it with the sponges. (N. Am. Geol. and Paleont., 1889, p. 155.)

In a private letter of the late Mr. U. P. James to Mr. W. M. Linney, of the Kentucky Geological Survey, dated August, 1879, are some remarks on this genus, which seem worthy of record. Mr. James says: "I have split longitudinally some of the Beatricea, and find, after rubbing them down smooth, a very remarkable structure. One specimen, less than an inch in diameter and about two inches long, shows a central core, about one-third the size of the specimen, with cup-shaped diaphragms, outside of which is a sort of reticulated structure

made up, apparently, of short pieces, with interstices (?) distinct, and rather open nearest the core and becoming more and more compact outwardly, till, at the outer edge, they are very close together, with hardly any divisions visible. In another specimen, 1¼ inches long and the same in diameter, the core has become decomposed and left a hollow space, with indistinct marks of the diaphragms, but otherwise the characters are the same." After referring to Billings's belief, that the fossils were plants, and to Hyatt's that they were cephalopods, Mr. James says: "I do not feel fully satisfied with the conclusions of either, but until more light is thrown upon the subject, it is the best, perhaps, that can be done with these remarkable fossils." Two species only of the genus have been described. These are given below.

1.— B. NODULOSA, Billings, 1857.

Surface covered with oblong, oval, or sub-triangular projections, 1 to 3 lines high, with rounded, blunt points nearer one end of the prominence than the other; projections varying in size, sometimes with a nearly circular base, sometimes 6 or 7 lines long and one-half as wide, distant 1 or 2 lines from each other, arranged in rows or spirals; whole surface fretted with minute points, showing perforations when worn; septa thin, very concave, one line to one inch apart. (Rept. Geol. Sur. Canada, for 1853-'54-'55-'56, 1857, p. 343.)

Locality.— Anticosti Island; Marion County, Ky.; Connersville, Indiana. It has not been recorded from Ohio as far as known.

2.— B. UNDULATA, Billings, 1857.

Surface sulcated longitudinally by short, irregular, wave-like furrows, from two lines to one inch across; otherwise like the preceding; specimens sometimes 10 feet long and from 8 to 14 inches in diameter. (Ibid., p. 344.)

Locality.— Anticosti Island; Marion County, Ky.; Richmond, Indiana.

Remarks.— These two species are very closely allied and have been united by some writers. (Knott, Geol. of Marion County, Kentucky, p. 32). Prof. Hyatt considers them distinct, and says they can be separated by internal characters.

The first species has been found at Connersville, Indiana, by Mr. A. C. Benedict, and the second at Richmond, Indiana, by Dr. C. E. Beecher, of Yale College Museum. The latter gentleman has furnished the following statement as to the size of the specimen, which is in two pieces, and evidently does not represent the full length. One piece is 13 inches long, 2⅝ inches in diameter at the larger, and 1⅞ inches at the smaller end. The other is 15¼ inches long, 1¾ inches in diameter at the larger end, tapering to a flattened extremity ¼ by ¾ inches. Its total length must have been over 32 inches.

Class.—Actinozoa.

A division of the Cœlenterata, comprising the sea anemones, corals and allied forms, in which the mouth opens into an œsophageal tube, which, in turn, opens into the general body cavity; the œsophagus separated from the body wall by an intervening space, which is divided into a series of compartments by radiating vertical partitions, to the faces of which the reproductive organs are attached. (Nicholson, Man. of Paleont., vol. 1, 1889, p. 240.)

The forms may be simple, like a sea-anemone, or composite like a coral. They may increase in size in various ways: 1st, by lateral gemmation or budding; 2d, by calicular gemmation; 3d, by intermural gemmation; 4th, by basal gemmation, and 5th, by fission or division. The classification of the group is tentative. The members have been arranged under four sub-classes, but Nicholson (Ibid., p. 256,) arranges them under three, viz: Zoantharia, Alcyonaria and Ctenophora. The first two of these are represented in the Cincinnati Group. To these should probably be added Monticuliporoidea, which is here regarded as Cœlenteratal. This group is now entirely extinct. Lack of knowledge of the soft parts of the animal renders it impossible to place it with certainty. It has by some authors been transferred bodily to the Polyzoa; and by one it has been split up in such a way as to be part Cœlenteratal, part Polyzoal. In the latter case, unfortunately, many genera, seemingly closely allied, have been widely separated.

Sub-class ZOANTHARIA.

This has been split up into various orders, of which the *Zoantharia sclerodermata* or *Madreporaria* of Nicholson, (Ibid., p. 263,) alone has representatives in the Cincinnati Group. Of the four sections of the order, *aporosa*, *rugosa*, *fungida* and *perforata*, three are known to occur, the first, second and last.

Section 1.—*Madreporaria aporosa.*

Here the corallum is "composed of more or less compact and solid sclerenchyma, the theca or wall surrounding the visceral chamber being complete and not perforated by apertures or pores." (Nicholson, Ibid., p. 264.) Of the numerous genera, only one is found in our section, as below.

Genus 1.—COLUMNARIA, Goldfuss, 1826.

"Corallum composite, massive, composed of polygonal, closely-compacted and contiguous corallites, which are united by their walls, but do not possess mural pores. Walls of the corallites not excessively thickened. Septa well developed, typically extending nearly to the center of the visceral chamber, and alternately large and small. Tabulæ extremely well developed, complete and horizontal. No columella or cœnenchyma." (Nicholson, Pal. Tabulate Corals, 1879, p. 191; Goldfuss, Petrefacta Germaniæ, vol. 1, 1826, p. 72; Ibid., 2d ed., vol. 1, 1862, p. 67.) *Favistella*, Hall, 1847, Pal. of N. Y., vol. 1, 1847, p. 275.

Remarks.—The description above given is that of Nicholson, and is more comprehensive than the original. It does not, however, differ essentially. There can be no doubt about *Favistella*, Hall, being a synonym, but for comparison it is given below.

Favistella, Hall, 1847.—"Coral massive, hemispherical or globose, composed of polygonal tubes or cells, which increase by interstitial tubes or by lateral development of tubes upon the margins of the mass; cells divided transversely by closely arranged diaphragms, and longitudinally by radiating dissepiments; extremities of the tubes star-form; rays (dis-

sepiments) about 12, more or less, meeting in the center. The rays generally reach one-half or two-thirds of the distance from the margin to the center." The following species have been found in the rocks about Cincinnati.

1.— C. ALVEOLATA, Goldfuss, 1826.

Corallum massive, subhemispheric or pyriform, often attaining a very considerable size; corallites prismatic, hexagonal or pentagonal, but often more or less drawn out along one axis, the larger ones being from rather less than two to over three lines in their long diameter, and having numerous much smaller tubes interspersed among them; walls of the corallites more or less amalgamated, the line between contiguous tubes still remaining quite distinct; mural pores apparently wanting; septa unequally developed, alternately large and small, the latter quite rudimentary, and the former extending usually across two-thirds of the distance between the wall and the axis of the visceral chamber, or even reaching the last mentioned point; septa thin and flexuous, but completely lamellar, the number of each series varying from 12 to 15 or more; tabulæ complete, horizontal or somewhat flexuous, about six in the space of two lines; calices polygonal, unequally sized, moderately deep, with thin margins, usually closely contiguous, but sometimes separated by slight interspaces; the floor formed by the uppermost tabula, the surface of which is striated by the radiating septa. (Nicholson, Pal. Tabulate Corals, 1879, p. 195; Goldfuss, Pet. Germ., vol. 1, 1826, p. 72; Ibid., 2d ed., vol. 1, 1862, p. 68.) *Favistella stellata*, Hall, Pal. of N. Y., vol. 1, 1847, p. 275.

Locality.—Cincinnati and various places in the vicinity; New York, Canada, etc.

Remarks.—The above is the description given by Nicholson, and is much fuller than the original. There is no doubt about Hall's *Favistella stellata* being a synonym.

2.— C. CALICINA, Nicholson, 1874.

"Corallum subhemispheric or pyriform, of moderate but not very large dimensions. Corallites partially in contact,

and partially more or less completely separate from one another, averaging about two lines in diameter, but varying from less than a line up to three lines. When the corallites are more or less uniformly contiguous (as always toward the base of the colony), they are prismatic and polygonal. In diverging from the base, however, the tubes separate from one another to a greater or less extent, so as to leave more or less conspicuous intervals between them. In these portions of their course each corallite is surrounded by a distinct and separate wall, which is marked exteriorly by strong vertical ridges, and intervening grooves, about five of which occur in the space of one line, together with five encircling striæ. Septa alternately large and small, 28 in number altogether, the primary ones being continued over the upper surfaces of the tabulæ to near the center of the corallites, whilst the secondary ones are marginal and rudimentary. Tabulæ well developed and complete, about three in the space of one line. Increase by calicular gemmation, combined with parietal budding." (Nicholson, Pal. Tabulate Corals, 1879, p. 197.) *Favistella calicina*, Nich., Rept. Brit. Asso. Adv. Sci., 1874; 2d Rept. Pal. of Ontario, 1875, p. 24. *Columnaria hertzeri*, Rominger, Foss. Cor. Michigan, 1876, p. 90.

Locality.—Cincinnati and vicinity, Kentucky, Ontario.

Remarks.—As will be observed, Nicholson first referred this species to *Favistella*, but later changed it to the genus here given. Rominger's description is as follows:

C. hertzeri: "Colonies of tubes, partially in close contiguity, of polygonal form, and intimately united with their walls; partially free, circular, laterally joining into chain-like rows, not unlike *Halysites*, or opening singly on the surface. Diameter of tubes three mm. Structure otherwise entirely corresponding with the associated form, *Columnaria stellata*. Is described by Nicholson under the name *Favistella calycina*." (Palæontology. Fossil Corals [of Lower Peninsula of Michigan] Geol. Sur. Mich., vol. 3, pt. 2, 1876, p. 91.)

3.—C. (?) HALLI, Nicholson, 1879.

"Corallum forming large massive colonies, which vary from a few inches to several feet in diameter, and which are

composed of variously-sized polygonal corallites, in close contact with one another throughout their entire length. The walls of the corallites are not excessively thickened, and they are so completely amalgamated in contiguous tubes that even under the microscope the original line of demarcation between the tubes can be made out with difficulty or not at all. The large tubes are usually from two to three lines in diameter, though occasionally considerably smaller than this; and the smaller corallites are of all sizes. Septa marginal, in the form of obtuse longitudinal ridges, which vary in number from 20 to 40, do not extend to any distance into the visceral chamber, and are not divisible into an alternating longer and shorter series. Tabulæ strong, horizontal and complete, about half a line apart or sometimes closer." (Pal. Tabulate Corals, 1879, p. 200.)

Locality.—Cincinnati or places in vicinity (?).

Remarks.—This species was established by Nicholson to include the coral described by Hall, Billings and others as *Columnaria alveolata*. It is not that species, however, and Dr. Nicholson has, therefore, given it this new name. It has been recorded from Cincinnati by Mr. Ulrich, (Cat. Foss. Cin. Gr., 1880), but Nicholson says it is mainly a Trenton form.

[TO BE CONTINUED.]

REMARKS ON THE STEMS AND ROOTS OF CRINOIDS FROM NEAR LEBANON, OHIO.

BY DR. D. T. D. DYCHE.

Two or three years since, I concluded to find out, if I could, the character of the termination of the column of the crinoid Heterocrinus subcrassus.

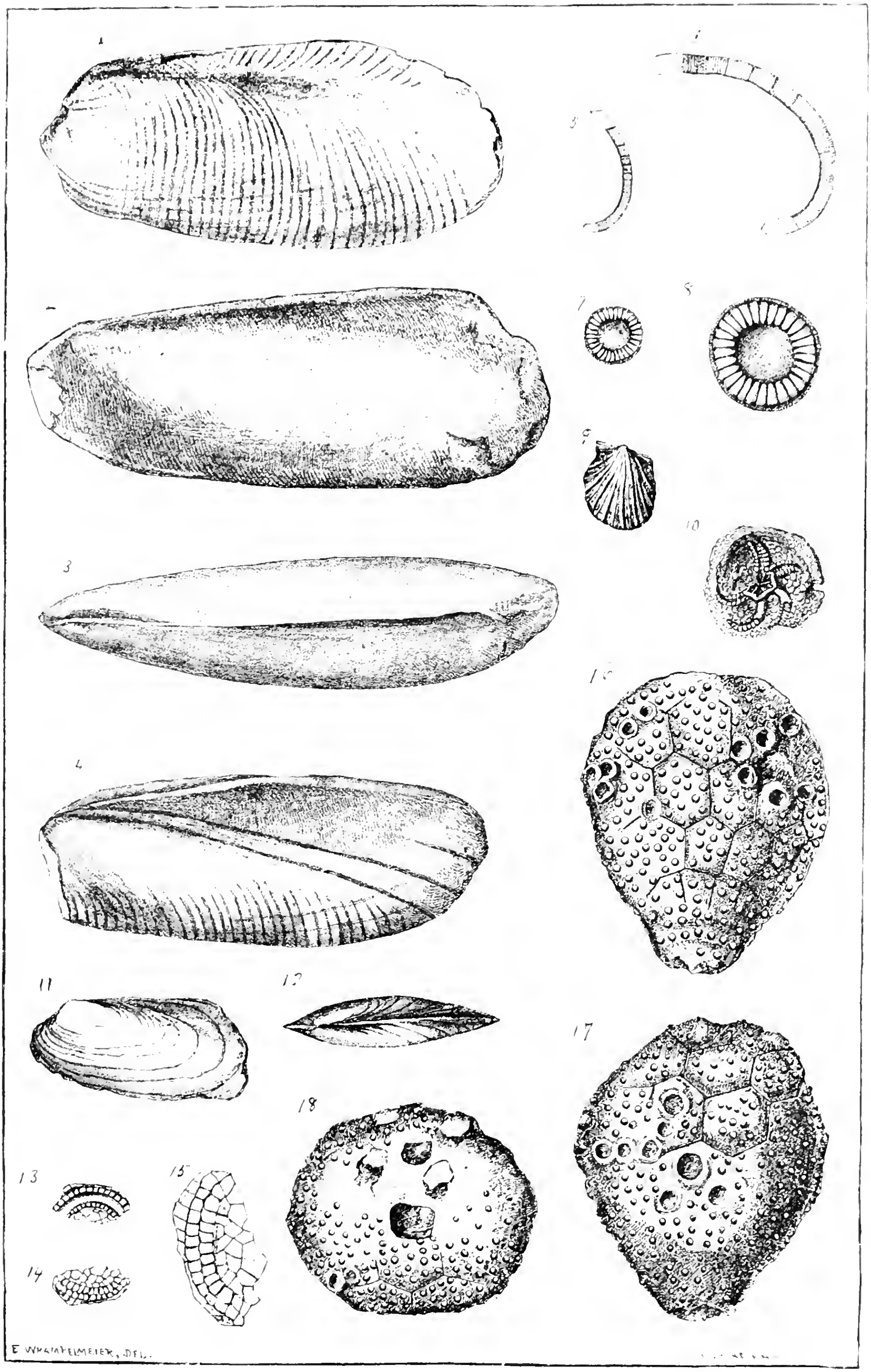
Having a lower silurian slab with about one hundred specimens of the calyx, with a great profusion of the columns diverging in every direction, I selected a column attached to its calyx and followed it by uncovering, until I was rewarded by discovering the column diverging into well-defined roots; length of column from calyx 12½ inches, about 1¼ inches under the surface.

At this time I believed that the genus Glyptocrinus floated, and was devoid of bases, or roots. About eighteen months ago, something caused me to doubt this, and I commenced the investigation of the termination of the column, and now, after a great deal of work, and after many discouragements, I have been able to so far develop roots on the terminations of the columns of Glyptocrinus neali, G. dyeri, and G. baeri, that I have a specimen of each species, showing the calyx, column, and roots intact on the slab, one slab of G. baeri having on its surface several specimens of that character.

One character of the specimens surprised me. The diversity of the length of the columns between calyx and roots in the specimens just mentioned. The column of G. neali from two to four or five inches, G. baeri from one-half inch to six or eight, G. dyeri from one to four or five inches between calyx and roots.

I have also found a specimen of Heterocrinus simplex, showing calyx, column, and inverted saucer-like base attached to another column.

EXPLANATION OF PLATE I.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THE JOURNAL

OF THE

Cincinnati Society of Natural History.

VOL. XV. · CINCINNATI, OCT., 1892, JAN., 1893 · NOS. 3 & 4.

PROCEEDINGS.

September 6, 1892.

The regular September meeting of the Society was called to order at 8.19 P. M., with President Collier in the chair.

The minutes of June 7 were read and approved.

The application of W. F. Howell, as an acting member, was ordered posted.

Upon motion, the President was instructed to write each of the several persons whose resignations are now before the Society, calling attention to the changes that have been made in the Museum, and urging their reconsideration.

The report of the Committee upon the Death of Dr. Byrnes was read and ordered filed.

Mr. Dury made some remarks upon Albino robins, calling especial attention to their enemies.

A general discussion followed concerning the Albinos of different birds and mammals.

Adjourned.

December 6, 1892.

The regular December meeting of the Society was called to order, with Vice-President Langdon in the chair.

The minutes of September 6 were read and approved.

The applications of Messrs. Charles Barnes and W. A. Eudaly were read and ordered posted.

The reading of the minutes of the Executive Board was postponed.

Mr. Davis L. James read an interesting paper upon the Mango (Magnifera indica), which was followed by a very hearty general discussion.

The following donations were presented and received, to-wit:

From Mr. D. L. James, three Short-Tailed Shrews (Blarina brevicauda).

From R. H. Galbreath, by Dr. O. D. Norton, one Agate and one Turkish Turquois.

DONATIONS.

D. L. James, three Short-Tailed Shrews (B. brevicauda).

R. H. Galbreath, by Dr. O. D. Norton, one Agate and one Turkish Turquois.

A. McLaughlin, one Great Horned Owl (Bobo virginianus).

Carlisle Murdock (seven years old), Green Snake Eggs (Liopeltis vernalis).

Donors name unknown, one Silver Lamprey (Ichthyomyzon argenteum).

Seth Hayes, Skull of Dog (Canis familiaris), Skull of Cat (Felis domesticus), Skull of European Swan (Cygnus der), Tongue of European Swan (Cygnus der).

Mrs. B. Van Ham, by Dr. O. D. Norton, one Skull from Florida mound.

EXCHANGES.

American Museum of Natural History, New York City.

American Journal of Science, New Haven, Conn.

American Academy of Arts and Sciences, Boston.

American Naturalist, Philadelphia.

American Philosophical Society, Philadelphia.

American Antiquarian, Mendon, Ill.

American Association for Advancement of Science, Salem, Mass.

The Auk, New York City.

American Monthly Microscopical Journal, Washington.

American Geographical Society, New York City.

Anthropological Society, Washington.

Academy of Natural Sciences, Philadelphia.

Albany Institute, Albany, N. Y.

American Garden, New York City.

American Geologist, Minneapolis, Minn.

Arkansas Geological Survey, Little Rock, Ark.

Boston Society of Natural History, Boston.

Botanical Gazette, Crawfordsville, Ind.

Bureau of Education, Washington.

Bureau of Ethnology, Washington.

Biological Society of Washington, Washington.

Buffalo Historical Society, Buffalo.

Connecticut Agricultural Experiment Station, New Haven, Conn.

California Academy of Sciences, San Francisco.

Cambridge Museum of Comparative Zoology, Cambridge, Mass.

Chicago Academy of Sciences, Chicago.

Connecticut Academy of Arts and Sciences, New Haven.

Columbus Horticultural Society, Columbus, O.

California State Mining Bureau, San Francisco.

Colorado Scientific Society, Denver.

Comparative Medicine and Surgery Journal, New York City.

Colorado College Scientific Society, Colorado Springs, Col.

Denison Scientific Association, Denison University, Granville, Ohio.

Davenport Academy of Sciences, Iowa.

Department of Agriculture, Washington.: Reports of Statistician; Division of Chemistry; Division of Entomology; Division of Forestry; Division of Botany; Division of Economic Ornithology and Mammalogy; Division of Pomology; Reports of the Secretary; Office of Experiment Stations; Bureau of Animal Industry; Journal of Mycology; Insect Life; Section of Vegetable Pathology; Weather Bureau.

Essex Institute, Salem, Mass.

Entomological Society, Washington.

Entomologica Americana, Brooklyn.

Elisha Mitchell Scientific Society, Chapel Hill, N. C.

Entomological News, Philadelphia.

Geological Survey of Alabama, Montgomery.

Geological Survey of Missouri, Jefferson City.
Illinois State Laboratory of Natural History, Champaign.
Indiana State Geologist, Indianapolis.
Illinois Geological Survey, Springfield.
Illinois State Museum of Natural History, Springfield.
Iowa Academy of Sciences, Des Moines.
Iowa Agricultural College, Ames.
Johns Hopkins University, Baltimore.
Kansas Historical Society, Topeka.
Kansas University Quarterly, Lawrence.
Kentucky Geological Survey, Frankfort.
Kentucky Agricultural Experiment Station, Lexington.
Kansas Experiment Station, Manhattan.
Kansas City Scientist, Kansas City, Mo.
Linnean Society of New York City.
Leander McCormick Observatory, University of Virginia, Charlottesville.
Massachusetts State Board of Agriculture, Boston.
Michigan State Agricultural College, Agricultural College, Mich.
Minnesota Geological and Natural History Survey, Minneapolis.
Maryland Academy of Sciences, Baltimore.
Meriden Scientific Association, Meriden, Conn.
Marine Biological Laboratory, Wood's Holl, Mass.
The Microscope, Washington.
Minnesota Academy of Natural Sciences, Minneapolis.
Missouri Botanical Garden, St. Louis.
The Nautilus, Philadelphia.
Newport Natural History Society, Newport, R. I.
New Jersey Natural History Society, Trenton.
New York Microscopical Society, Flatbush, L. I., New York.
New York Academy of Sciences.
New York State Museum, Albany.
New York Experiment Station, Geneva.
New Orleans Academy of Sciences.
New Jersey Geological Survey, New Brunswick.
Natural History Society of Wisconsin, Milwaukee.
Natural History of New York, Albany.
National Academy of Sciences, Washington.

Oberlin College Library, Oberlin, Ohio.

Ohio State Board of Agriculture, Columbus.

Ohio Agricultural Experiment Station, Wooster.

Ornithologist and Oologist, Boston.

Peabody Museum of Arch. and Ethnology, Cambridge, Mass.

Psyche, Cambridge, Mass.

Philosophical Society, Washington.

Public Museum, Milwaukee, Wis.

Pennsylvania Geological Survey, Philadelphia.

Rochester Academy of Science, Rochester, N. Y.

St. Louis Academy of Natural Sciences, Mo.

State Historical Society of Wisconsin, Madison.

School of Mines Quarterly, Columbia College, New York City.

Smithsonian Institution, Washington.

Staten Island Natural Science Association, New Brighton.

Torrey Botanical Club, Columbia College, New York City.

Technical Society of the Pacific Coast, San Francisco.

United States National Museum, Washington.

United States Fish Commission, Washington.

United States Geological Survey, Washington.

United States Naval Observatory, Washington.

University Studies, University of Nebraska, Lincoln.

University of Minnesota, Agricultural Experiment Station, St. Anthony Park, Minn.

University of Iowa, Iowa City.

United States General Weather Service, Washington.

Vassar Brothers' Institute, Poughkeepsie, N. Y.

War Department, Surgeon General's Office, Washington.

Washburn College Laboratory, Topeka, Kas.

Wisconsin Academy of Science, Arts and Letters, Madison.

Wagner Free Institute of Science, Philadelphia.

West American Scientist, San Diego, Cal.

Zoological Society of Philadelphia.

FOREIGN.

Academia Nacional de Ciencias, Cordova, Argentine Republic.

Augsburg Naturhistorischen Verein, Augsburg, Germany.

Argentina Historia Natural, Florentino Ameghino, Buenos Ayres.

Academie des Sciences, Inscriptiones et Belles-lettres, Toulouse, France.

Botanical Society, Edinburgh, Scotland.

Botanischen Verein der Provinz Brandenburg, Berlin.

Braunschweig Verein fur Naturwissenschaft, Braunschweig, Germany.

Bristol Naturalists Society, Bristol, England.

Barcelona Academia de Ciencias y Artes, Barcelona, Spain.

Basel Naturforschenden Gesellschaft, Basel, Switzerland.

Bremen Naturwissenschaftlichen, Bremen, Germany.

Bern Naturforschenden Gesellschaft, Bern, Switzerland.

Belgique Societa Malacologique, Brussels.

Cassel Verein fur Naturkunde, Cassel, Germany.

Canadian Entomologist, London, Ontario.

Canadian Record of Science, Montreal.

Canada Geological and Natural History Survey, Ottawa.

Canadian Institute, Toronto.

Comite Geologique du Russie, St. Petersburg.

Deutschen Gesellschaft fur Natur und Volkerkunde Ostasicens, Yokohama, Tokio.

Deutschen Wissenschaftlichen Verein zu Santiago, Chili.

Deutschen Wissenschaftlichen Verein in Mexico.

Edinburgh Geological Society, Scotland.

Ethnologische Mittheilungen aus Ungam, Budapest, Hungary.

Geological Society of London, England.

India Geological Survey, Calcutta.

India Survey Department, Calcutta.

Italy, Ministero di Agricoltura Industria e Commercio, Rome.

Japan Imperial University, Tokio.

Kaiser Leop-Carol. Deutschen Akademie der Naturforschen, Halle, Prussia.

Kaiser König Geologischen Reichsanstalt, Vienna.

K. K. Naturhistorischen Hofmuseum, Vienna.

Kongl. Vetenskaps Akademiens Forhandlinger, Stockholm.

Kiew, Societe des Naturalistes, Kiew, Russia.

La Societe Botanique Suisse, Geneva, Switzerland.

L'Institute Royal Geologique de la Swede, Stockholm.

Linnean Society, New South Wales.

Leipzig, Verein für Erokunde, Germany.

Manchester Literary and Philosophical Society, England.

Museo Nacional, Rio de Janerio.

Manitoba Historical and Scientific Society, Winnipeg.

Museo Nacional de Mexico, Mexico.

Museo Nacional, Republica de Costa Rica, San Jose.

Naturforschenden Gesellschaft, Zürich.

Natural History Society of Trencsin, Hungary.

Netherland Zoological Society, Leiden, Holland.

Natural History Society, Glasgow, Scotland.

Nova Scotian Institute of Natural Sciences, Halifax.

New South Wales, Department of Mines. Hon. Minister for Mines, Sidney, Australia.

Oberhessiche Gesellschaft für Natur- und Heil-kunde, Giesen.

Ottawa Field Naturalists Club, "Ottawa Naturalist," Canada.

Ontario Entomological Society, London, Ontario.

Royal Society, Edinburgh.

Royal Physical Society, Edinburgh.

Royal Society, New South Wales.

Royal Microscopical Society, London.

Royal Geological Society of Cornwall, Penzance, England.

Royal University of Norway, Christiania.

Royal College of Physicians, Edinburgh.

Revue Internationale de Bibliographie, Beyrouth, Syria.

Royal Society of South Australia, Adelaide.

Societe des Sciences Naturelles, Nantes.

South African Philosophical Society, Cape Town.

Societa Toscana di Scienza Naturali, Pisa, Italy.

Sociedad Mexicana de Historia Natural, City of Mexico.

Societe Imperiale des Naturalistes de Moscow, Moscow, Russia.

Sociedad Cientifica Antonio Alzate, City of Mexico.

Societe Africana d' Italia, Naples.

Societatum Litterae, Frankfort on Oder.

Societe Entomologique de France, Paris.

Schweizerischen Botanischen Gesellschaft, Zürich, Switzerland.

Torino Musei di Zoologia ed Anatomia Comparata, Turin, Italy.

Verein für Vaterlandische Naturkunde in Wurttemburg, Stuttgart, Germany.

Victoria, Public Library, Museum and National Gallery, Melbourne.

Westfalischen Provinzal Verein fur Wissenschaft und Kunst, Munster, Germany.

OBSERVATIONS CONCERNING FORT ANCIENT.

By Selden S. Scoville, M. D., Lebanon, Ohio.

(Paper read by Abstract, at the Rochester Meeting of The American Association for the Advancement of Science, 1892.)

There have been so many articles and maps published descriptive of Fort Ancient, that we shall take it for granted that all are familiar with its situation and general features.

Our remarks will include a description of the ground and water courses at the eastern part of the works, and the character of the high embankments that cross the neck of the peninsula, with observations regarding the purposes of the gate-ways, and also a few thoughts bearing upon the question as to whether all the earth-works seen at Fort Ancient were constructed at the same period of time.

It is to be regretted that no map has ever been published which fully illustrates the topography of the ground at the eastern part of the fort, and that extending to the northeast, on which the two large mounds and long parallel walls are situated. In our description of the ground and water courses, we shall not claim to be strictly accurate, as we have made no regular survey, but we hope to be approximately correct.

The two streams — twin streams we may call them — which pass down, one on either side of the peninsula, on which the fort stands, rise about three-fourths of a mile northeast of the fort. In their upper parts they have excavated quite wide, though not deep beds, in the glacial clays; but before reaching the fort they begin to cut down vigorously into the lower silurian shales and limestone, and soon form large hollows or ravines. A short distance from their sources they diverge and are more widely separated for some distance, but upon approaching the fort come much nearer together, forming what has been known as the neck of the peninsula or plateau, on which the fort proper is situated. They again diverge at

this point, the north stream taking a due west course to reach the Little Miami River; the other a south-west direction to reach the same stream nearly three-fourths of a mile below the mouth of its companion.

At the neck of the peninsula the north stream has formed a ravine fully seventy feet in depth; while the one to the south has acquired a depth of from thirty-five to forty feet. From the brow of the north ravine, in a S. S. W. direction, to the brow of the south ravine, the distance is about sixty-two rods. The direction here indicated is that taken by the line of high embankments in crossing this neck of ground. But the line is by no means straight. To follow its devious course the distance is about seventy-five rods, or thirteen rods greater than a direct line.

On this neck of land, about midway between the large ravines, rises a little stream or branchlet, which runs south, bearing a trifle west to enter the large ravine that lies in this direction. It is only about thirty rods in length, but by the time it reaches the ravine it has excavated a bed fully twenty feet in depth. In the upper part of its course it makes quite a curve to the west.

About eight or ten rods north of the head of this branchlet rises another similar stream, which runs north, bearing a little west, to enter the north ravine. It is from twenty to twenty-five rods in length, and in its course curves somewhat to the east, or in an opposite direction from the one just described. This branchlet, a few yards before it enters the large hollow, is joined by another tiny stream coming down from the southeast. It is only ten or twelve rods in length.

It is proper to state that the two branchlets first described, particularly in their upper parts, are not at this time well defined. The wearing down of the high embankments, which were constructed immediately on their western borders, and the cultivation of the adjacent fields have, in places, almost obliterated them. This is noticeable particularly with the one that enters the north ravine. It is at this time well defined only in its lower part, where it has formed a gully fifteen feet in depth. The construction of the Chillicothe and Lebanon turnpike, which emerges from the Fort here, contributed to its obscurity. A number of years ago we were informed by

an elderly gentleman, who knew the place when covered with the primitive forest, that these streamlets were well defined, and during wet seasons of the year contained quite an amount of running water.

The idea has been advanced that these small streams were at first artificial ditches, formed during the construction of the line of embankments. There is nothing to favor such an idea. In proof of their being natural, and having existed when the fort walls were constructed, we have but to call attention to the singular and devious course the line of embankments takes in crossing the neck of the peninsula. Instead of pursuing a direct course, as undoubtedly would have been the case had these branches not existed, it makes reverse curves, and in shape resembles the letter S, though the curves are not as short or abrupt as seen in this letter. The line of embankments was constructed on the western borders of the streams, and made to conform to their curves, which we have described above. There is evidence that during the building of the walls these streams, in their upper parts, were deepened, in order to afford greater protection to the works, and to obtain material for the embankments.

We are now prepared to say that the narrow piece of ground between the heads of the first branchlets described, and which is only eight or ten rods wide, must be regarded as the true neck of the peninsula on which the fort is situated, and was the only place that an entrance could be effected without encountering natural defenses in the way of branches, ravines and valleys. By viewing the ground immediately outside of the fort, we shall not fail to see that the neck of ground named marks the true divide or water-shed between the large ravines. This can not be determined by observations on the inside of the fort, because here the ground, in order to obtain material for the walls and for other purposes, was leveled off to almost the evenness of a brick yard.

The middle of the Chillicothe and Lebanon road, where it passes between the two large mounds, marks the true water-shed at that point. This is about twenty-two rods east of where the road leaves the fort, and about ten rods further north than the point we have described as the true neck of the peninsula.

The two parallel walls, which form the guarded road-way, as it has often been styled, start off, we know, from the large mounds, and run in a north-east direction for the distance of over half a mile. This guarded-way commences on the true water-shed, and by the direction taken, it is enabled to keep on the divide, thus avoiding the larger streams and their numerous branches.

A careful study of the character of the ground immediately to the north and south of the two large mounds can not fail to throw some light on the nature of the two ditches that are seen here. We will be convinced that they are artificial, and that they were not constructed simply for drainage purposes, as has been frequently suggested. The natural drainage from the mounds is good in both directions; and if it had been desirable to improve this by constructing open sewers, different directions would have been taken, as being more efficient and much less expensive. Especially will this apply to the moat that starts from the mound on the south side of the road. Here the natural course for a drain is toward the southeast, where it could, in a short distance, be made to enter a small ravine. It bears, however, more toward the south on higher ground, and throughout most of its course has less fall than if carried in a different direction.

The directions and positions of these moats at once suggest that they were constructed for defensive or strategic purposes. They could be used as rifle-pits, or more properly bow-pits; and, besides, would serve as passways to enable persons to enter the guarded roadway from the large ravines unobserved. Warriors from the villages in the river bottoms, by means of the large ravines, these moats and the guarded-way, could pass entirely unobserved to the high ground northeast of the fort, which would make a distance of fully a mile and a quarter.

The guarded-way, we have said, is over half a mile in length. Its direction from the large mounds is generally given as northeast. Its true bearing, however, is a few degrees further toward the east. Whatever may have been the real object in constructing this long passway, it seems to have been necessary that it should reach the high ground east of the fort. This could have been accomplished in about

half the distance by taking a south-east direction. And to have gone directly east would have shortened the distance nearly one-third. But neither of these routes was practicable, on account of the valleys and streams that lie in these directions. The only practical route was the one taken. Had the builders varied the direction either way, to the extent of only three or four degrees, the heads of several little streams would have been encountered.

The high ground referred to consists of a wide ridge, with an elevation above the ground at the fort of thirty-five or forty feet. From this ridge a view could be had in every direction for at least eight or ten miles, provided the country was devoid of timber, which was probably the case, except along the larger water courses.

While the real object in constructing this guarded-way is in great doubt, we can see how it might have been of great service in times of danger. The little mound that stands in the farther end, on the high ground, could be used as an observatory, or as a place from which to make signals, either by flags, fire or smoke, to the surrounding villages belonging to the Fort Ancient nation. A strong out-post, if necessary, could be maintained in the expanded end of the road-way which encloses the mound. Large forces could be thrown out into the road-way to harrass the flanks of an advancing foe.

All the indications tend to show that this guarded roadway was constructed for military purposes. And it is quite certain that the enemy most dreaded by the inhabitants in and about Fort Ancient were a people inhabiting the country to the northeast.

Our attention will now be directed to the line of high embankments which crosses the neck of the peninsula from one large ravine to the other. This is divided by the openings or gate-ways into six sections. Their length on top varies from about seventy-five to a hundred and fifty-seven feet. The seven gate-ways have a top width of from fifty to seventy-seven feet. The perpendicular height of the embankments varies from seventeen to twenty-two feet. These sections of wall, taken collectively, form two curves, as we have illustrated. But taken separately, they are found to be perfectly

straight. It will be seen, then, that the turns or changes in direction take place at the openings or gate-ways. This arrangement exhibits quite a high degree of engineering skill. By adopting this plan, the sections of wall could be built straight, thus saving much labor.

The third section of wall, south of the north ravine, and which stands immediately south of the Chillicothe and Lebanon road, has the greatest elevation, which is twenty-two feet. It has a top-length of seventy-eight feet and a width of base of seventy-four feet. The angle of slope of sides is about thirty-six degrees. Its summit, though well rounded off, is quite massive, so that by a very little leveling down, it would be sufficiently wide to accommodate a standard-gauge railway. In all respects, except in size and length, this section of wall does not differ materially from the others.

A person standing some distance to the west, on the inside of the fort, will be surprised at the evenness of the summits of this and the next two much longer sections of embankments that extend to the south. And he will be more surprised when he notices how closely their tops range with each other, and at the almost exact horizontal line which is thus formed against the eastern sky. The straightness of this line is slightly marred by a downward curve of from eight to ten inches in the top of the section next to the road, caused, doubtless, by water standing at its base on the outside of the fort. This has affected the ground beneath the middle of the wall, causing it to settle.

This accurate summit-range is the more remarkable, when we consider that these sections of wall vary considerably in height, as measured from the surface of the ground. We must conclude that this accurate top-range was intentional on the part of the builders, and that the reason of its remaining unchanged is owing to the fact that the height of the embankments has been but very little affected since their construction. If these sections of wall had been carried up to a considerable distance above their present elevation, and to quite a narrow ridge, as many suppose, and then worn down by natural agencies to the height we now find them, there would be no such accurate summit-range. The extent of wearing of the different sections would not be the same. And it would

be very strange if the top of each section did not present a very uneven appearance.

From our frequent visits to Fort Ancient, and a careful study of these high embankments, we can come to no other conclusion than that when first constructed they had flat summits, and that their elevation, as we have endeavored to show, was never but slightly greater than at present.

At a number of the openings in the embankments of the fort, we can ascertain the original width of base of the walls by finding stones which were evidently used to retain the first earth placed in the embankment by the builders.

Some twenty-five years ago, when visiting the fort, I discovered that there had been considerable earth removed from the end near the ground of the high section of embankment, next to the Chillicothe and Lebanon road. The object was to widen the passage of this thoroughfare. By an examination of the excavation, I discovered stones placed in such positions as to clearly indicate the original width of base of the embankment. This, as near as I could measure at the time, was found to be fifty-four feet. About ten feet of earth on either side of the embankment lay outside of these little retaining walls, and which had been washed down since the earth-wall was first constructed. This section of embankment, it will be remembered, has at the present time a ground-width of seventy-four feet.

The question now arises as to where the earth that has been carried down since the embankment was constructed came from. Certainly not from off the very top or center of the wall, if we concede that there has been no great change in its height. It must have come chiefly from the sides at or near the top. If the top of the wall was flat, as we have claimed, the first and important wear would be upon the angles, and not until these were well worn off would the center of the embankment be much affected.

By estimating the amount of earth that lies on either side of the walls, outside of their original bases, we may form some idea of not only the original top-width of these embankments, but the angle of slope of their sides. In our reconstruction of these high embankments, we would give them the form of an elongated truncated pyramid. Taking the

highest section, or that which stands immediately south of the road, we would say that its original height was twenty-four feet, or two feet higher than at present. The decrease in elevation we would attribute in part to settling of the wall. The width of base was fifty-four feet, as before stated. Width of summit, somewhere between fifteen and twenty feet. Slope of sides, fifty or fifty-five degrees.

We think it highly probable that all of the enclosing walls of Fort Ancient had flat or level summits. But it was at the north-eastern part of the fort where such a form of embankment was most needed. Here was the place of greatest danger. It has been the custom in all ages of the world for the inhabitants of a walled town or city, when the place was attacked, to make their defense principally from the tops of the walls. And it was often necessary to have room for quite a large force, in order to repel the assaults of the enemy. Now, we can not suppose that the inhabitants of Fort Ancient formed an exception to this mode of defensive warfare.

There is evidence that the north-eastern part of the fort was set apart as a place of assembly, whether for civil, religious, social or military purposes, we can not, of course, positively determine. But we believe that it was used as a military camp, or at least as a place of general rally of the warriors in times of danger. Here are a number of acres that have been smoothed off very evenly. The portion of this level area adjoining the high embankments presents a most remarkable evenness of surface. To fully appreciate this a person should view it from the road just inside of the fort.

All indications go to show that the north-east part of the fort was regarded by the inhabitants as the point of greatest danger. Hence this military *campus*, and the massive walls with wide summits, ready to be mounted with files of hardy warriors, armed with bow and battle-ax, whenever the fort was in danger of being assaulted.

In this connection we will refer briefly to the earth-work in the northern part of the fort, known as the crescent or semicircle. It is 270 feet long, about sixteen feet wide at base and not over two feet high. From a careful study of its character, location and immediate surroundings, we have come to regard it as the remains of a complete circle that once

existed here, the diameter of which was about 280 feet. Like nearly all circular earth-works, it probably had but one opening or gate-way, and this is still plainly visible near the center of the portion remaining. It is twenty-four feet wide, and looks to the northwest. This opening is so distinct that we have been surprised by not seeing it mentioned by any of the writers on Fort Ancient who have spoken of this crescent.

Assuming that our opinion concerning this earth-work is correct, a little more than two-thirds of the circle which lay to the southeast has been removed; and, as we believe, by the builders of the fort, in order to extend the area of level ground, to which reference has been made. The material was used either in the construction of the large investing embankments, or in filling up the head of a ravine that is seen a short distance south of the road. There is evidence that the heads of several small ravines were filled in preparing this level piece of ground.

The gate-ways of Fort Ancient. The first one south of the Chillicothe and Lebanon road, in the line of high embankments, was, doubtless, the grand entrance for this part of the fort. It is situated at the true neck of the peninsula which we have descrlbed. It had, when first constructed, a top-width of probably sixty feet, and a ground-width of from twenty to twenty-six feet. Situated on the inside of the fort, and extending a short distance into the gate-way, there was a parapet, most likely circular in form, with an elevation but little more than one-fourth that of the embankments. The remains of this parapet are easily recognized.

There are, we know, over seventy artificial openings or gate-ways in the enclosing wall of the fort. The presence of so many is a puzzling question, in view of the quite positive evidence that the works were constructed for defensive purposes. There are fully as many, if not more, at places where the builders apprehended danger, as elsewhere. We have an illustration of this at the north-eastern part of the fort. At all points, where the works could be more easily approached by an enemy, the walls were made higher. But in no instance was the number of gate-ways lessened

Shall we conclude that there was something strategic in the design of these openings? Did they serve as places where

the besieged could make sallies and retreats, in order to draw the enemy within the enclosure to be captured? We know that almost all barbarous, or semi-civilized people, regard the capture of their enemies of as much or more importance as killing them in battle.

While these openings may have served the purpose here indicated, the weight of evidence seems to favor the idea that they were designed to afford ready means of egress and ingress for the inhabitants of the place and surrounding country, the same as we find with all walled town or cities in both ancient and modern times. Probably they were furnished with means of closure, but no evidence of such provision has as yet been discovered. However, no thorough exploration of these passages has ever been made. They are generally filled with two or three feet of earth that has been carried down from the ends of the walls.

It appears somewhat strange that nearly all the earth-works in Ohio and elsewhere in the Mississippi valley, which afford positive evidence of having been constructed for defensive purposes, have numerous openings or gate-ways. While those suspected of having a ceremonial or symbolic signification, have, as a rule, very few. The circular ones generally have but a single opening.

Most likely, if we could know all the circumstances under which these old works at Fort Ancient were constructed, we would have a better idea of the purposes of the openings. The three and a-half miles of massive walls were not planned and constructed under circumstances of immediate danger. Evidence of cool deliberation and wise calculation is stamped on every feature of the works. Perhaps few modern engineers could show greater skill in constructing earth-works than that exhibited by the old Mound Builders at Fort Ancient.

The indications, we think, favor the idea that when the building of the heavy enclosing walls was first contemplated, the circumstances surrounding the people had greatly changed. While pressing emergencies did not actually exist, they were discerned in the near future — probably the long and relentless struggle for supremacy in the Mississippi Valley, between the Short Heads from the South, and the more barbarous Long Heads from the North, had already assumed a very

serious aspect, and it was thought necessary to fortify by building a Chinese wall (?) around the town. Not, perhaps, to protect simply the town itself, but to afford a place of refuge for the inhabitants of the surrounding country in times of great peril. But why do we associate the investing line of embankments at Fort Ancient with a defensive work of the Orientals by calling it a Chinese wall? The answer to this question, we trust, will be found in the following brief remarks:

We shall not be much at variance with eminent authority on archæology by saying that there are strong grounds for the belief that in very early times there appeared in the great Mississippi Valley, as occupants of the country, people representing the two leading branches of the great Mongolian family of Eastern Asia. There were the wild North American Indians, who came from the old Chinese Tartars, and who, it is to be presumed, found their way into the New World by the way of Behring Straits. The other adventurers were a less barbarous people, and came from the more enlightened Chinese. At a time long ago, they drifted from their home in the East across the Pacific into Central America, or Yucatan, and finally, by the extension of their civilization northward, reached the Mississippi Valley.

We know something of the hostilities that existed in the East between these Mongolian branches, and that it was thought necessary on the part of the more civilized people to build a great wall 1,200 miles in length, as a defense against their wild and ferocious brethren.

Here in the Mississippi Valley, by the same Mongolian blood, was engendered a similar strife for supremacy; and defensive works, such as we see at Fort Ancient, were ultimately constructed by the more civilized party to the warfare. But the results of fortifying, it would seem, were not as successful as in the case of the Celestials in the East.

There is, we think, unmistakable evidence that the large earth-works constructed on sites strongly fortified by nature, such as we see at Fort Ancient, mark the beginning of the end of the old Mound Builder civilization, at least so far as regards the Ohio Valley. The last permanent occupants, and perhaps the builders of the fort, were, most likely, the people

whose remains are found in rude stone cists in the embankments, and in other places, particularly in the river bottoms. Their bones are much better preserved than those found in the mounds about the fort, notwithstanding the conditions of sepulture were very unfavorable for the preservation of human remains.

There is no question but that there is a vast difference in the age of the earth-works in Ohio and elsewhere in the Mississippi Valley. And we are of the opinion that there is quite a differance in the age of those seen at Fort Ancient. There are indications that the parallel walls, the different mounds, the crescent, and perhaps the two moats, were constructed long before the heavy enclosing walls. When these minor works were first seen by the white settlers, they were much more worn than any portion of the investing walls. Before the land was cleared and cultivated, the parallel walls were so flattened down as to very much resemble ordinary road-beds. The early settlers always spoke of them as roadways. The crescent, although it has never been disturbed by plow or harrow, is much worn down, and so smoothly and compactly blended, as it were, with the natural ground, that the casual observer would hardly suspect that it was artificial. It has every indication of being much older than the large embankments. We have already indicated that it existed when the Fort proper was built.

There can be but little doubt that the peninsula, on which the fort stands, was occupied by the Mound Builders long before it was invested with high walls. And if our opinion is correct, the artificial defenses consisted of the long guarded-way, probably the two moats, and the contiguous mounds. These works, however, partook largely of a strategic character, and were not designed wholly for the protection of the dwellers on the peninsula, but for the inhabitants of the surrounding villages as well. There were at least two of these old-time villages in the river bottom near the fort. Their sites are now three feet or more below the surface of the ground.

MORDELLIDÆ IN THE VICINITY OF CINCINNATI, OHIO.

By Charles Dury.

The *Mordellidæ*, as collected by most collectors (if taken by them at all, which is seldom the case), are so poorly handled that they are almost worthless for study. Many of those which I have received have been almost buried in glue, thereby obscuring the characteristic markings; when an attempt is made to clean them they fall to pieces. During the Summer of 1892, I devoted much of the season to this family, with gratifying success. The locality seems to be very rich. Some of them occur in prodigious numbers. Imperfect and denuded specimens give but a poor idea of the beauty of these nimble little insects when fresh, and with their pubescence perfect. They should always be collected in a cyanide bottle, and kept dry and perfectly clean. None of the family should ever be pinned, but always mounted on triangles of thin card board. They are quite difficult to mount, owing to their narrow, flattened form, and the glue should be thick and quick setting to hold them in an upright position on the triangle until dry. Use a very small quantity of glue, too much obscures characters. The posterior legs in *Mordellistena* should be drawn out behind to better exhibit the ridges on tibia and tarsi, which seem to be such an excellent specific character. A strong glass and good light are necessary to properly study these ridges. The excellent synopsis of the family by John B. Smith (Trans. Amer. Ent. Soc., July, 1882,) leaves little to be desired. While many of the species occur abundantly on blossoms, I get some of the rarest and most interesting by sweeping weeds growing in the woods with a sweep net. Early morning and late in the afternoon are the best times to secure them, for during the heat of mid-day they are so active jumping around in the net or umbrella, and flying away so

quickly, that it is very difficult to get them into a bottle. With us the first individuals of the family appear about the middle of May, and reach their maximum numbers during June, but by the middle of July most of them have gone. I give below notes on some of the species, and also a list of them, which may assist in throwing a little light on geographical distribution:

PENTARIA.

trifasciata Mels., common, taken abundantly on the foliage of an osage orange hedge, June.

ANASPIS.

rufa Say, common.

TOMOXIA.

bidentata Say, common.
linella Lec, common.
hilaris (Say), rare.

The three species above are found about dead beech timber, but with the destruction of the trees the beetles have become scarce.

MORDELLA.

melæna Germ., rare.
scutellaris Fab., common.
octopunctata Fab., common.
marginata Melsh., common.
lunulata Hel., rare.
serval Say, abundant; always found resting on the underside of logs, mostly beech.
oculata Say, abundant.
triloba (Say), abundant.
undulata Mels., rare.
discoidea Mels., not common.

GLIPODES.

sericans Mels., rare.

MORDELLISTENA.

bicinctella Lec., rare; a very variable species both in size and markings. In one the thorax is entirely black; in another there is a dark basal cloud; in another the thorax is very pale. The width of elytral bands is also variable.

arida Lec., rare.

lutea Melsh., common.

trifasciata Say, rare.

lepidula Say, rare.

limbalis Melsh., not rare.

biplagiata Helm,, an abundant species, and the first that appears in the Spring (May), occurring on blossoms of the "Haw" (Viburnum).

decorella Lec., rare.

bipustulata Hel., rare.

picipennis Smith, rare.

fulvicollis Melsh, rare.

militaris, Lec., rare.

comata Lec., common.

aspersa Mels., rare.

tosta Lec., abundant.

amica Lec., rare.

infima Lec., rare.

varians Lec., common.

gramica Lec., common.

ustulata Lec , common.

My series point to the conclusion that the three above are color varieties.

semiusta Say, rare.

nigricans Mels., rare.

pustulata Mels., abundant.

convicta Lec., not rare.

splendens Smith. I have a specimen which I think is this species, but it differs from the type in having one ridge less on the first joint of tibia. When fresh, was of a sage-green color, but in drying has faded to pale silvery. A very pretty species.

morula Lec., rare.

ambusta Lec., common.

unicolor Lec., with pustulata, our most abundant species.
marginalis Say, common.
pubescens Fab., common.
bihamata Mels., common. This species is exceedingly active, jumping about in the net like a flea. M. discolor resembles it superficially, but is not nearly so active.
liturata Mels., common.
fuscata Mels., common.
suturella Helm., one specimen.
attenuata Say, one specimen.
discolor Mels., two specimens.
æmula Lec., one specimen (teste Horn).

In addition to the fifty-three species enumerated above, I have several *Mordellistena* which I think are new; one of them is near the Californian *vilis*, Lec. I hesitate to describe them, as there seems to be too many species now.

AVONDALE, January 6, 1893.

THE MYXOMYCETES OF THE MIAMI VALLEY, OHIO.

By A. P. Morgan.

First Paper.

(Read January 3, 1893.)

MYXOMYCETES, Wallr.

Fructification essentially a minute membranaceous vesicle, the SPORANGIUM inclosing the SPORES, the product of a motile protoplasmic body called the PLASMODIUM.

Microscopic organisms with the habit of the Fungi. The ripe spore of the Myxomycetes is globose or ellipsoidal in shape, with the epispore colorless or colored, and smooth or marked by characteristic surface — sculpture according to the species; the spore in germination gives rise to an elongated protoplasmic body, which exhibits amoeboid movements, and is known by the name of *swarm-cell*. The swarm-cells multiply by bipartition, which may be repeated through several

Preston, Hamilton County, Ohio, December 28, 1892.

Mr. Davis L. James:

Dear Sir—Along with this I send you the first installment of the papers, entitled "The Myxomycetes of the Miami Valley, Ohio."

The work in these papers is based upon my ample collection of Myxomycetes growing in this region, comprising more than one hundred species; these have been diligently compared with specimens obtained from correspondents elsewhere in this country and in Europe.

At the same time, I have also included many extra limital species. This has been done chiefly to more clearly elucidate the subject in places where the local material is not sufficient.

The only apology I can make for the arrangement which I present, is that I have been obliged to choose from several different systems. I have aimed not to hamper myself, by attaching paramount importance to some particular character throughout.

I purpose to furnish a synopsis of the whole at the end of the work.

Very truly yours, A. P. Morgan.

generations; they then unite together to form the large motile protoplasmic bodies named *plasmodia*. The newly-formed plasmodium is distinguished by its greater size from the swarm-cells, while it exhibits essentially the same movements and changes of shape. The plasmodia gradually increase in size, and as they grow assume commonly the form of branched strands; these spread over the surface of the substratum, which is usually the decaying parts of plants, in the form of veins and net-works of veins, giving rise to a copiously-branched reticulated or frill-like expansion, which covers surfaces varying in extent from a few to several centimeters. They are chiefly composed of a soft protoplasm of the consistence of cream, which may be readily spread out into a shapeless smear, and is usually colorless, but sometimes exhibits brilliant colors of yellow, orange, rose, purple, etc. The development of the plasmodium ceases with the formation of the *spores* within their *sporangia*.

The formation of the sporangia out of the plasmodium appears under three general forms, which, however, pass into each other and are, therefore, not strictly limited.

First: An entire plasmodium spread out on its substratum becomes transformed into a sporangium, or it divides into a variable number of unequal and irregular pieces, each of which undergoes transformation. Such a sporangium lying flat on the substratum, more or less elongated and flexuous, often branched and reticulate, is termed a *plasmodiocarp*.

Second: Erect sporangia on a narrow or stalk-like base, begin as node-like swellings on the branches of the plasmodium, and gradually rise to their ultimate form as the surrounding protoplasm flows into them and assumes an upward direction. These sporangia are nearly always perfectly regular in shape; they may be globose, obovoid, somewhat depressed, or more or less elongated, and are either stipitate or sessile.

Third: A number of plasmodia collect together from every side and become fused into a single body, often of considerable dimensions; from these combinations originate the large spore-receptacles which are called *æthalia*. The component sporangia may be regular in shape, standing close together, in a single stratum, with entire connate walls; more

often, being elongated and flexuous, they branch and anastomose freely, their walls becoming perforated and more or less defective; in other cases, the æthalium is a compound plasmodiocarp, the narrow sinuous sporangia branched and anastomosing in all directions, forming an intricate network, closely packed together and inseparable. The surface of the æthalium is often covered by a continuous layer of some excreted substance, which is called the *common cortex*.

The wall of the sporangium, typically, is a thin, firm membrane, colorless and pellucid, or colored in various shades of violet, brown, yellow, etc.; it is sometimes extremely delicate, as in Lamproderma, or is scarcely evident, as in Stemonitis; in other instances it is thickened by deposits on the inner surface, as in Tubulina, or by incrustations on the outer surface, as in Chondrioderma. The stipes are tubes usually with a thick wall, which is often wrinkled and folded lengthwise, and is confluent above with the wall of the sporangium; in some cases the stipe also enters the sporangium, and is more or less prolonged within it as a *columella*. The stipe commonly expands at the base into a membrane, which fastens it to the substratum, and is called the *hypothallus;* when all the stipes of the same group of sporangia stand upon a single continuous membrane, it is called a *common hypothallus*.

In the simplest forms, the cavity of the sporangium is filled exclusively with the numerous spores; but in most all of the genera, tubules or threads of different forms occur among the spores and constitute the *capillitium*. The capillitium first makes its appearance in Reticularia, in which upon the inner surface of the walls of the sporangia there are abundant fibrous thickenings; next in Cribraria it is spread over the inner surface of the wall, and is early separated from it; here, also, it first assumes a more definite form and arrangement; in Physarum it is in connection with the wall of the sporangium only by its extremities while it traverses the interior with a complicated network; in Stemonitis and its allies the capillitium originates wholly from the columella; in most species of Arcyria it issues from the interior of the stipe. The capillitium in Trichia consists of numerous slender threads which are *free*, that is, are not attached in any way; they are usually simple and pointed at each extremity; the surface of these threads exhibits beautiful spiral markings.

Order I. LICEACEÆ.

Sporangia always sessile, simple and regular or plasmodiocarp, sometimes united into an æthalium. The wall a thin, firm, persistent membrane, often granulose-thickened, usually rupturing irregularly. Spores globose, usually some shade of umber or olivaceous, rarely violaceous.

The species of this order are the simplest of the Myxomycetes; the sporangium, with a firm, persistent wall contains only the spores. There is no trace of a capillitium, unless a few occasional threads in the wall of Tubulina prefigure such a structure. To the genera of this order is appended the anomalous genus Lycogala, which seems to me better placed here than elsewhere.

Table of Genera of Liceaceæ.

1. Licea. Sporangia simple and regular or plasmodiocarp, gregarious; hypothallus none.
2. Tubulina. Sporangia cylindric, or by mutual pressure becoming prismatic, distinct or more or less connate and æthalioid, seated upon a common hypothallus.
3. Lycogola. Æthalium with a firm membranaceous wall; from the inner surface of the wall proceed numerous slender tubules, which are intermingled with the spores.

I. LICEA, Schrad. Sporangia sessile, simple and regular or plasmodiocarp, gregarious, close or scattered; hypothallus none; the wall a thin, firm membrane, sometimes thickened with scales or granules, breaking up irregularly and falling away or dehiscent in a regular manner. Spores globose, variously colored.

The sporangia are not seated on a common hypothallus; they are, consequently, more or less irregularly scattered about on the substratum.

1. LICEA VARIABILIS, Schrad. Plasmodiocarp not much elongated, usually scattered, sometimes closer and confluent, somewhat depressed, the surface uneven or a little roughened and not shining, reddish-brown or blackish in color; the wall a thin, firm pellucid membrane, covered by a dense outer layer of thick brown or blackish scales, rupturing irregularly. Spores in mass pale ochraceous, globose or oval, even or nearly so, 13–16 mic. in diameter.

Growing on old wood. Plasmodiocarp 1–1.5 mm. in length, though sometimes confluent and longer. The wall is thick and rough, not at all shining. It is evidently the species of Schweinitz referred to by Fries under this name.

2. LICEA LINDHEIMERI, Berk. Sporangia sessile, regular, globose, gregarious, scattered or sometimes crowded, dark bay in color, smooth and shining; the wall a thin membrane with a yellow-brown outer layer, opaque, rupturing irregularly. Spores in mass bright bay, globose, minutely warted, opaque, 5–6 mic. in diameter.

Growing on herbaceous stems sent from Texas. Sporangia about .4 mm. in diameter. The bright bay mass of spores within will serve to distinguish the species. The thin brown wall appears dark bay with the inclosed spores.

3. LICEA BIFORIS, Morgan, n. sp. Sporangia regular, compressed, sessile on a narrow base, gregarious; the wall thin, firm, smooth, yellow-brown in color and nearly opaque, with minute scattered granules on the inner surface, at maturity opening along the upper edge into two equal parts, which remain persistent by the base. Spores yellow-brown in mass, globose or oval, even, 9–12 mic. in diameter. See Plate III, Fig. 1.

Growing on the inside bark of Liriodendron. Sporangia .25–.40 mm. in length, shaped exactly like a bivalve shell and opening in a similar manner. I have also received specimens of this curious species from Prof. J. Dearness, London, Canada.

4. LICEA PUSILLA, Schrad. Sporangia regular, sessile, hemispheric, the base depressed, gregarious, chestnut-brown, shining; the wall thin, smooth, dark-colored and nearly opaque, dehiscent at the apex into regular segments. Spores in the mass blackish-brown, globose, even, 16–18 mic. in diameter.

Growing on old wood, Sporangium about 1 mm. in diameter. On account of the color of the spores the genus *Protoderma* was created for this species by Rostafinski. It is number 2,316 of Schweinitz's N. A. Fungi.

II. TUBULINA. Pers. Sporangia cylindric, or by mutual pressure becoming prismatic, distinct or more or less connate and æthalioid, the apex convex, seated upon a common hypothallus; the wall a thin membrane, minutely granulose, firm and quite persistent, gradually breaking away from the apex downward. Spores abundant, globose, umber or olivaceous.

The sporangia usually stand erect in a single stratum, with their walls separate or grown together: in the more compact æthalioid forms, however, the sporangia, becoming elongated and flexuous, pass upward and outward in various directions, branching and anastomosing freely. See Plate III, Figs. 2, 3, 4.

1. TUBULINA CYLINDRICA, Bull. Sporangia cylindric, more or less elongated, closely crowded, distinct or connate, pale umber to rusty-brown in color, seated on a well developed hypothallus; the wall thin, firm, with minute veins and granules, semi-opaque, pale umber, often iridescent Spores in mass pale umber to rusty-brown, globose, most of the surface reticulate, 6–8 mic. in diameter.

Growing on old wood, mosses, etc. Æthalium circular or irregular in shape, from one to several centimeters in extent, the individual sporangia 2–4 mm. in height. Plasmodium at first milky-white, soon changing to bright red, then to umber, becoming paler when mature and dry.

2. TUBULINA CASPARYI, Rost. Sporangia more or less elongated, closely crowded and prismatic, connate, pale umber to brown in color, seated on a conspicuous hypothallus; the wall thin, firm, minutely granulose, semi-opaque, pale umber, iridescent when well matured; all or many of the sporangia traversed by a central columella, from which a few narrow bands of the membrane stretch to the adjacent walls. Spores in the mass pale umber to brown, globose, the surface reticulate, 7–9 mic. in diameter.

Growing on old prostrate trunks. Æthalium two or three to several centimeters in extent, the individual sporangia 3–5

mm. in height. Plasmodium white, the immature sporangia dull-gray tinged with sienna color. The columella, with its radiating bits of membrane, is the same substance as the wall; it may be a reëntrant edge of the prismatic sporangium, caused by excessive crowding together; at least, this may be regarded as its origin; there may have arisen some further adaptation. The species is *Siphoptychium Casparyi*, Rost. I am indebted to Dr. George A. Rex for the specimens I have examined.

3. TUBULINA CÆSPITOSA, Peck. Sporangia short-cylindric, closely crowded, distinct or connate, argillaceous olive to olive-brown in color, seated on a well-developed hypothallus; the wall a thin membrane, with a dense layer of minute dark-colored round granules on the inner surface. Spores argillaceous olive in the mass, globose, minutely warted, 6–8 mic. in diameter.

Growing on old wood. Æthalium in irregular patches sometimes several centimeters in extent, the single sporangia about 1 mm. in height. Plasmodium dark olivaceous, the sporangia blackish if dried when immature, taking a paler shade of olivaceous, according to development and maturity. This is *Perichæna cæspitosa*, Peck. in the 31st N. Y. Report.

III. LYCOGALA. Mich. Æthalium with a firm membranaceous wall; from the inner surface of the wall proceed numerous slender tubules, which are intermingled with the spores. The material of the wall appears under three different forms: the inner layer is a thin membrane, uniform in structure, of a yellow-brown color, and semi-pellucid; the outer layer consists of large flat roundish or irregular vesicles, brown in color, filled with minute granules, and arranged in one or more strata; from these vesicles originate the tubules, which traverse the wall for a certain distance, and then enter the interior among the spores; the tubules are more or less compressed, simple or branched, and the surface is ornamented with warts and ridges, which sometimes form irregular rings and reticulations.

If the sporophores in this genus be regarded as simple sporangia, which is the view that Rostafinski takes of one of

the species, the tubules are simply the peculiar threads of a capillitium. If, however, the æthalium is a compound plasmodiocarp, the tubules stand for the original plasmodial strands and, consequently, represent the component sporangia.

1. LYCOGALA CONICUM. Pers. Æthalia small, ovoid-conic, gregarious, sometimes close together with the bases confluent, the surface pale umber or olivaceous marked with short brown lines, regularly dehiscent at the apex. The wall thin; the outer layer not continuous, the irregular brown vesicles disposed in angular patches and elongated bands, which have a somewhat reticulate arrangement. The tubules appear as a thin stratum upon the inner membrane; they do not branch, and they send long slender simple extremities inward among the spores. Spores in mass pale ochraceous, globose, minutely warted, 5–6 mic. in diameter. See Plate III, Fig. 5.

Growing on old wood. Æthalium 2–5 mm. in height, the tubules 3–8 mic. in thickness. This is *Dermodium conicum* of Rostafinski's monograph, but the structure is essentially the same as in the other species. Massee evidently did not have specimens of this species. I have never seen any branching of the tubules either in the wall or in the free extremities of the interior.

2. LYCOGALA EXIGUUM, Morg. n. sp. Æthalia small, globose, gregarious, the surface dark brown or blackish, minutely scaly, irregularly dehiscent. The wall thin; the vesicles with a dark polygonal outline, disposed in thin irregular reticulate patches, which are more or less confluent. The tubules appear as an interwoven fibrous stratum upon the inner membrane; they send long slender branched extremities inward among the spores. Spores in mass pale ochraceous, globose, nearly smooth, 5–6 mic. in diameter. See Plate III, Fig. 6.

Growing on old wood. Æthalium 2–5 mm. in diameter, the threads 2–10 mic. in thickness, with very slight thickenings of the membrane. The polygonal vesicles give a reticulate appearance to the dark-brown patches which ornament the surface of the wall.

3. LYCOGALA EPIDENDRUM, Buxb. Æthalia sub-globose,

gregarious, sometimes closely crowded and irregular, the surface umber, brown or olivaceous, minutely warted, at length, irregularly dehiscent at or about the apex. The wall thick, the brown vesicles loosely aggregated and densely agglutinated together, traversed in all directions by the much-branched tubules, which send long-branched extremities inward among the spores; the main branches thick and flat, with wide expansions, especially at the angles, the ultimate branchlets more slender and obtuse at the apex. Spores in the mass from pale to reddish ochre, globose, minutely warted, 5–6 mic. in diameter. See Plate III, Fig. 7.

Growing on old wood. Æthalium 5–12 mm. in diameter, the width of the tubules varying from 12–25 mic. in the main branches, with broader expansions at the angles, to 6–12 mic. in the more slender final branchlets. This is one of the most common of the Myxomycetes; it grows in all countries, and in this region may be found on old trunks at all seasons of the year.

4. Lycogala flavofuscum, Ehr. Æthalia large, subglobose or somewhat pulvinate, solitary or gregarious, the surface at first silvery-shining, becoming yellow-brown, minutely areolate, irregularly dehiscent The wall very thick and firm, hard and rigid; the thick outer layer of roundish brown vesicles closely compacted in numerous strata; from the vesicles of the lower strata the long and broad much-branched tubules proceed into the interior among the spores; the ultimate branchlets clavate and obtuse at the apex. Spores in the mass pale ochre, cinerous or brownish, globose, minutely warted, 5–6 mic. in diameter. See Plate III, Figs. 8, 9.

Growing on old trunks. Æthalium 1 to several centimeters in diameter, the width of the tubules varying from 25–60 mic. in the main branches, with sometimes much broader expansions at the angles, to 10–25 mic. in the ultimate branchlets. The brown vesicles of the outer wall are easily separated from each other and emptied of their contents by maceration; it is then seen that a thin pellucid membrane incloses numerous roundish granules, much resembling the spores, but usually a little larger, 5–8 mic. in diameter.

ORDER II.—RETICULARIACEÆ.

Sporangia simple, regular and stipitate, or compound, forming an æthalium; the wall a thin membrane with distinct fibrous thickenings upon the inner surface, the membrane, or at least certain portions of it, disappearing usually at the maturity of the spores, leaving behind the more permanent fibrous thickenings as a more or less definite capillitium. Spores globose, purple, brown, ochraceous, rarely violaceous.

In this order the threads of a capillitium first make their appearance; but they are confined to the inner surface of the wall of the sporangium, being set at liberty by the early decay of the outer membrane.

TABLE OF GENERA OF RETICULARIACEÆ.

a. Æthalia.

1. RETICULARIA. Æthalium composed of numerous slender sinuous sporangia which repeatedly branch and anastomose.

2. CLATHROPTYCHIUM. Æthalium composed of numerous regular erect sporangia.

b. Sporangia simple.

3. CRIBRARIA. Capillitium of slender threads combined into a network of polygonal meshes.

4. DICTYDIUM. Capillitium of numerous convergent ribs, which extend from base to apex, and are united by fine transverse fibers, thus forming a network of rectangular meshes.

I. RETICULARIA, Bull. Æthalium composed of numerous slender sinuous sporangia, which repeatedly branch and anastomose, closely packed together and seated upon a com-

mon hypothallus, the apices of the final branches coherent at the surface, and naked or covered by an additional corticate layer. Walls of the sporangia consisting of a thin membrane, with abundant fibrous thickenings, presenting broad expansions, narrowing to thin flat bands, and reduced in many places to slender fibrous threads. Spores abundant, globose, umber or violaceous.

After the maturity of the spores disintegration of the sporangial wall begins, the thin membrane disappearing more rapidly than the fibrous thickenings or the portions of the sporangial walls near the base, which are more compactly grown together; there is thus left at each stage an increasing number of the shreddy fibers mingled with the spores.

1. Reticularia splendens, Morg. n. sp. Æthalium pulvinate, circular or more or less elongated and irregular, seated on a conspicuous silvery hypothallus; the surface naked, bright umber, smooth and shining. Walls of the sporangia firm and quite persistent, pale umber, slowly disintegrating, consisting for the most part of wide expansions, with their angles tapering to narrow bands and slender threads. Spores in the mass pale umber, globose, most of the surface reticulate, 7–9 mic. in diameter. See Plate III, Fig. 10.

Growing on old wood. Æthalium from 1 to several centimeters in extent and 5–10 mm. in thickness, usually growing singly, rarely close enough to be confluent. This species has lately been referred to *Reticularia rozeana*, Rost., but it varies greatly from the account given of that species in the Journal of Botany for September, 1891.

2. Reticularia umbrina. Fr. Æthalium pulvinate, roundish, more or less irregular, the surface covered by a thin, silvery, shining, common cortex, which at the base is confluent with the hypothallus. Walls of the sporangia umber or rusty-brown next the base, with broad expansions in places thickly grown together, toward the surface passing into narrow bands and abundant fibrous threads, which rapidly disintegrate. Spores in the mass umber or rusty brown, globose, most of the surface reticulate, 7–9 mic. in diameter.

Growing on old trunks. Æthalium one to several centimeters in extent, and 5–15 mm. in thickness. The walls of the sporangia are much more reduced to the shreddy fibrous condition than in the preceding species, and on this account they much more rapidly disintegrate, causing the æthalium soon to collapse. It is *Reticularia Lycoperdon*, Bull.

3. RETICULARIA ATRA, A. & S. Æthalium pulvinate, variable in form and size, covered with a thin, fragile, blackish, cortical layer. Walls of the sporangia violaceous, next the base with broad expansions, in places more thickly grown together, toward the surface becoming narrow with more abundant fibrous threads, sometimes presenting a loose irregular network, the whole structure, however, quite variable, according to the stage of the disintegration. Spores globose, violet, minutely warted, 14–16 mic. in diameter.

Growing on wood and bark, especially of pine. Æthalium 2 or 3 to several centimeters in extent. This is *Amaurochæte atra* of Rostafinski's monograph, but the structure appears to be altogether similar to that of *Reticularia umbrina*.

II. CLATHROPTYCHIUM, Rost. Æthalium composed of numerous regular erect sporangia, seated in a single compact stratum, on a well-developed hypothallus, the surface formed by the coherent apices. Sporangia at first cylindric, with the apex convex and the wall entire; soon, by mutual pressure, they become prismatic and the lateral faces disappear, leaving the edges and the apex permanent. Spores globose, ochraceous.

1. CLATHROPTYCHIUM RUGULOSUM, Wallr. Æthalium composed of numerous very slender sporangia, closely compacted into a single stratum, and seated on a conspicuous silvery hypothallus; the surface ochroleucous, honey color or olivaceous. The sporangia are typically hexangular when the lateral faces disappear, leaving at the edges six simple triangular threads, extending from the angles of the hexagonal apex downward to the base. Spores in the mass ochraceous, yellowish or brownish, globose, minutely warted, 8–10 mic. in diameter.

Growing on old wood. Æthalium somewhat circular, or often quite irregular in shape, 1 to several centimeters in extent, the individual sporangia nearly 1 mm. in height, but scarcely .1 mm. in thickness. Deviations from the typical form of the sporangia sometimes occur, they are not seldom pentangular, and I have seen the apices quadrangular, with only four threads, or even triangular, and with but three; the threads, too, are said occasionally to branch and anastomose. *Reticularia plumbea*, Fries, S. M. III, 88; and *Ostracoderma spadiceum*, Schw., N. A. Fungi No. 2,381.

III. CRIBRARIA, Pers. Sporangia simple, globose or obovoid, stipitate, often cernuous; the wall regularly thickened on the inner surface in two ways, the lower basal portion by radiating ribs consisting of minute brown granules, the upper part by slender threads combined into a network of polygonal meshes; the basal portion of the membrane is commonly persistent with its thickening and is called the *calyculus*, the upper part nearly always disappears from the network at maturity; there are usually nodules of the brown granules at the angles of the network. Spores globose, purple, brown, ochraceous.

a. Sporangium, large.

1. Cribraria argillacea, Pers. Sporangia globose or obovoid, stipitate or nearly sessile, standing close together on a thin and evanescent hypothallus; the wall quite firm, silvery-shining, the greater portion persistent, breaking away about the apex; calyculus small, the brown radiating ribs soon passing into a network of polygonal meshes, the threads with irregular granulose-thickened portions at intervals throughout their whole extent. Stipe very short, erect, brown. Spores in the mass argillaceous, globose, 5–7 mic. in diameter.

Growing in large irregular patches on rotten trunks. Sporangia .6–.8 mm. in diameter, the stipe always much shorter than the sporangium, sometimes nearly obsolete. The resemblance of this species to some forms of *Tubulina cæspitosa* is very great.

2. CRIBRARIA VULGARIS, Schrad. Sporangium large, globose, stipitate, somewhat cernuous; the calyculus brown, finely ribbed and granulose within, occupying but a small part of the sporangium; the network of slender threads, with very small nodules at the angles, each with several (3–7) radiating threads, sometimes with one or two free extremities, the meshes triangular or rhombic. Stipe rather short, stout, tapering upward, usually a little bent or curved at the apex, dark purplish brown in color. Spores in the mass pale ochraceous, globose, even, 5–7 mic. in diameter.

Growing on old wood. Sporangium .5–.7 mm. in diameter, the stipe two or three times the diameter of the sporangium in length. Recognized by the large sporangium and the very small nodules with their few radiating threads.

3. CRIBRARIA DICTYDIOIDES, C. & B. Sporangium large, globose, stipitate, cernuous; the calyculus small, with thickish brown ribs, from which the outer thin membrane often disappears soon after maturity; the network of slender threads, with large brown nodules at the angles, more or less elongated and irregular in shape, each with numerous (5–15) radiating threads, usually some with free extremities, the meshes largely triangular. Stipe long, tapering upward, flexuous, curved at the apex, dark purplish-brown in color. Spores in mass pale ochraceous, globose, even, 5–7 mic. in diameter.

Growing on rotten wood, especially of oak. Sporangium .5–.6 mm. in diameter, the stipe from three to five times as long. This species appears to be intermediate between *Cribraria vulgaris* and *Cribraria intricata*; the nodules are usually large and irregular, but the characteristic parallel threads of *C. intricata* do not often occur. The outer membrane of the calyculus is by no means always absent.

4. CRIBRARIA ELEGANS, B. & C. Sporangium rather large, globose, stipitate, somewhat cernuous; the calyculus thickly coated inside with dark purple granules, faintly ribbed, occupying about a third part of the sporangium; the network of slender threads, with large irregular dark purple nodules, quite variable in shape and size, angular and lobed, below sometimes much elongated, the meshes very irregular. Stipe rather

short, tapering upward, bent at the apex, dark purple in color. Spores in the mass bright purple, globose, even, 5–7 mic. in diameter.

Growing on old wood. Sporangium .4–.5 mm. in diameter, the stipe two or three times as long. It does not appear to be greatly different from *Cribraria purpurea*, Schrad.

b. Sporangium, small.

5. CRIBRARIA TENELLA. Schrad. Sporangium small, globose, stipitate, cernuous; the calyculus brown, shining, granulose within and faintly ribbed, occupying from one-fourth to one-half the sporangium, sometimes the outer thin membrane early disappearing; the network of slender threads with small roundish or irregular nodules at the angles, each with several (4–8) radiating threads, sometimes two or three with free extremities, the meshes triangular or rhombic. Stipe long, tapering upward, flexuous, curved at the apex, purplish-brown in color. Spores pale ochraceous in mass, globose, even, 5–7 mic. in diameter.

Growing on old wood. The sporangium .3–.4 mm. in diameter, the stipe three to five times as long. This is a much more delicate species than *Cribraria dictydioides*. The calyculus is variable in size; in some examples the thin connecting membrane between the ribs has disappeared.

6. CRIBRARIA MICROCARPA, Schrad. Sporangium very small, globose, stipitate, somewhat cernuous; the calyculus represented by a few short brown ribs, the outer membrane soon disappearing; the network of slender threads, with small roundish nodules at the angles, each with several (4–6) radiating threads, with an occasional free extremity, the meshes largely rhombic. Stipe very long, slender, somewhat flexuous, bent at the apex, purplish-brown in color. Spores in mass pale ochraceous, globose, even, 6–7 mic. in diameter.

Growing on old wood. Sporangium .22–.27 mm. in diameter, the stipes 1–2 mm. in length. Readily distinguished by its very small sporangium and the comparatively very long stem. I am indebted to Dr. George A. Rex for specimens of this species.

7. Cribraria cuprea, Morg. n. sp. Sporangium very small, oval or somewhat obovoid, stipitate, cernuous; the calyculus copper-colored, finely ribbed and granulose within, occupying from one-third to one-half the sporangium; the network of slender threads, with rather large triangular or quadrilateral meshes, and with large irregular dark copper-colored nodules, each having several (4–7) radiating threads, with an occasional free extremity. Stipe not very long, tapering upward, curved at the apex, of the same color as the sporangium or darker below. Spores pale coppery in mass, globose, even, 6–7 mic. in diameter. See Plate III, Fig. 11.

Growing on old wood. Sporangium .30–.35 × .25–.30 mm., the stipe two to four times as long as the sporangium. A minute species, easily recognized by its almost uniform color of bright new copper.

IV. DICTYDIUM, Schrad. Sporangium simple, depressed-globose, stipitate, cernuous; the wall regularly thickened on the inner surface by numerous convergent ribs, which extend from base to apex and are united by fine transverse fibers, thus forming a network of rectangular meshes; the basal portion of the membrane sometimes persists as a calyculus, the upper part disappears at maturity. Spores globose, purplish.

The ribs run from base to apex like the meridians on a globe; they are simple, or here and there they separate into two divergent branches, which sometimes again converge into one; at the apex of the sporangium there is usually a small irregular net in which all the ribs terminate.

1. Dictydium cernuum, Pers. Sporangium depressed-globose, umbilicate at the apex, stipitate, cernuous, purplish-brown in color; the calyculus granulose within, occupying from one-fourth to one-third of the sporangium, the ribs united by firm, persistent fibers. Stipe not very long, erect, tapering upward, bent at the apex, purplish-brown, the apex pale and pellucid, standing on a small hypothallus. Spores purplish-brown in mass, globose, even, 5–7 mic. in diameter.

Growing on old wood. Sporangium .4–.5 mm. in diameter, the stipe two or three times longer than the diameter of the

sporangium. This appears to be the species figured and described by Rostafinski and by Massee.

2. DICTYDIUM LONGIPES, Morg. n. sp. Sporangium large, depressed-globose, the apex umbilicate, stipitate, cernuous, dark purple in color; calyculus usually wholly wanting, the ribs united by weak fibers, which are easily torn asunder, allowing the ribs to curl up inwards. Stipe very long, flexuous, tapering upward, curved and twisted at the apex, dark purple in color, standing on a thin hypothallus. Spores in the mass dark purple, globose, even, 5–7 mic. in diameter. See Plate III, Fig. 12.

Growing on rotten wood, mosses, etc. Sporangium .5–.7 mm. in diameter, the stipe three to five times as long. This is a much larger species than the preceding; it has a uniform dark purple hue, the stipe is very long and much bent and twisted, the ribs of the sporangium are soon torn apart and rolled inward.

MANUAL OF THE PALEONTOLOGY OF THE CINCINNATI GROUP.

By Joseph F. James, M. Sc., F. G. S. A., etc.

Part IV.

(Continued from Vol. xv, p. 100.)

(Read by Title, January 3, 1893.)

Section 2.—*Madreporaria rugosa.*

This section includes such well-known forms as *Zaphrentis, Cyathophyllum* and *Streptelasma*. Its general characters are given by Nicholson as follows:* Corallum simple or composite, composed of compact, solid sclerenchyma, the theca complete and imperforate; septa usually well developed and lamellar, with smooth or dentated edges; sometimes rudimentary, generally alternately long and short; mode of increase in the composite corolla mostly by lateral or calicular budding. Three of the genera of our corals are referred here, viz., *Zaphrentis, Streptelasma* and *Palæophyllum.*

Genus 1.—Zaphrentis, Rafinesque and Clifford, 1820.

"Corallum simple and trochoid; calice deep, septal fossula strongly developed and occupying the place of one of the septa; no columella; tabulæ moderately developed and bearing on their upper surface a series of septa, which extend from the wall to the center of the visceral chamber, and are denticulate all along their calicular edge." (Ann. Sci. Phys. de Bruxelles, tome v, 1820, p. 234; Ed. and Haime, Brit. Foss. Cor. (Palæont. Soc. Pub., (London, 1850, p. lxv.)

Remarks.—The above description is not the original one of Rafinesque and Clifford, this not being accessible, but the

*Manual of Palæontol., 1889, vol. 1, p. 276.

later one of Edwards and Haime. Only one species has been recorded from the Cincinnati group.

1.—Z. (?) OHIOENSIS, James, 1879.

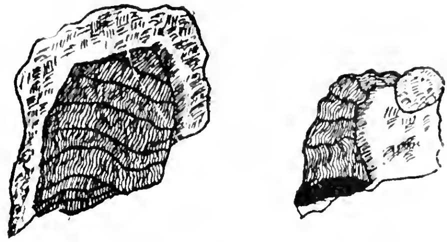


FIG. 8.—*Zaphrentis ? ohioensis*, James. Two examples nat. size. Original.

Corallum small, simple, sub-cylindrical, expanding quite rapidly from the base upward; sharply curved about the middle; epitheca thin; slight undulations, and numerous fine encircling lines crossing the small, closely set, longitudinal, sinuous costæ; margin of calice thin; interior and septa not known, being covered in all the examples by rock or other corals; three-fourths of an inch in diameter across the cup and one inch in length. (The Palæontologist, No. 4, July 10, 1879, p. 26.)

Locality.—Mt. Auburn, Cincinnati, O.

Remarks.—Subsequent to the published description, the author of this species was inclined to question its validity. It is inserted here in order that it may receive study from others. The figures are from type specimens in Mr. James's collection.

Genus 2.—STREPTELASMA, Hall, 1847.

Corallum simple, turbinate, free; epitheca well developed; septa well developed, more or less twisted and united with one another toward the center of the visceral chamber, where they sometimes form a species of vesicular tissue; no columella and no dissepiments; tabulæ remote, irregular, and poorly developed; a single septal fosette. (Pal. of N. Y., vol. 1, 1847, p. 69; Nicholson, Pal. of Ohio, vol. 2, 1875, p. 217.)

Remarks.—The above is the description given by Nicholson, as it is fuller than that of Hall. Numerous species have been

referred to the genus, some of them from our own section, but there does not seem good reason for making more than one from the Cincinnati group. It has also been questioned whether it is not the same as *Petraia* described by Munster in 1837. Billings and others have so considered it, but we shall here regard it as distinct.

1.—S. CORNICULUM, Hall, 1847.

Corallum conical, slightly curved or nearly straight, averaging from one to four inches long, and from ten lines to 1½ inches in diameter; septa from 90 to 160, alternately large and small; smaller ones rarely extending much beyond the margin, but the larger ones reaching to the center, where they become more or less twisted and united with one another, forming a mass of vesicular tissue: calice moderately deep; septa very thick, often appearing as if double; tabulæ remote and irregular, sometimes elevated toward the center of the visceral chamber; no dissepiments; epitheca with longitudinal ridges corresponding to the septa within; otherwise smooth, or, rarely, with a few encircling folds. (Pal. of N. Y., vol. 1, 1847, p. 69; Nicholson, Pal. of Ohio, vol. 2, 1875, p. 218.

Locality.—Oxford, Waynesville, Lebanon, Loveland, Cincinnati and other places in Ohio and Indiana.

Remarks—One of the most common of the fossils of the Cincinnati group, and generally known as the "bull's horn coral." It varies greatly in size—from ½ inch to 4 inches in length. It may be nearly straight or considerably curved, and with a sharp, or a rounded, blunt point. The description above is from the Palæontology of Ohio. It is possible that *Zaphrentis* (?) *ohioensis* may be only a small variety of this species.

Genus 3.—PALÆOPHYLLUM, Billings, 1857.

Corallum fasciculate or aggregate; corallites surrounded by a thick wall; radiating septa extending the whole length; transverse diaphragms either rudimentary or none; increasing by lateral budding. (Geol. Sur. of Canada, Rept. Prog. for 1853, '54, '55, '56, 1857, p. 168; Nicholson, Pal. of Ohio, vol. 2, 1875, p. 219.)

Remarks.—This genus is closely allied to *Streptelasma*, differing from it only in forming masses instead of being single and simple.

1.—P. DIVARICANS, Nicholson, 1875.

Corallum usually free, sometimes apparently attached, compound, formed of from 2 to 6, conical, turbinate corallites, produced by lateral gemmation, or by fission, directed outward from the parent at a more or less open angle and not again in contact; septa from 58 to 62, alternately large and small, large ones twisted toward center of visceral chamber; no dissepiments or columella; tabulæ unknown; epitheca well developed, with ridges corresponding to the septa within, with faint encircling striæ and a few shallow annulations of growth; calice deep, with a flattened space at bottom; free edges of septa without spines or denticulations. (Pal. of Ohio, vol. 2, 1875, p. 220.)

Locality.—Oxford, etc., O.

Section 3.—*Madreporaria perforata.*

Simple or composite, with the corallum more or less porous or reticulate; septa solid or porous, represented by irregular trabeculæ [plates or bars] or calcareous spines; dissepiments usually present, and tabulæ commonly developed. (Nicholson, Man. of Pal., 1889, vol. 1, p. 306.)

This section includes many of the large, widely distributed and best known genera of Paleozoic corals, among them being *Favosites*. Only three genera are represented in our section, and these with only a few species. They are *Alveolites*, *Protaræa*, and *Calapæcia* (*Columnopora*).

Genus 1.—ALVEOLITES, Lamarck, 1801.

Corallum massive, incrusting or ramose, composed of contiguous, compressed corallites, which possess thin walls and open obliquely upon the surface by sub-triangular or semilunar calices; septa sometimes obsolete, but often present in the form of longitudinal rows of spinules, which may be equally developed or reduced to a single, double or treble row by the suppression of the others; tabulæ well developed, com-

plete; mural pores generally few in number, of large size and irregular in their distribution. (Systemé des Animaux sans Vertèbres, 1801, p. 375; Nicholson, Palæozoic Tab. Corals, 1879, p. 117.)

Remarks.—The description given above is that of Nicholson, and it is much more complete than the original of Lamarck. The generic characters are very fully discussed by the former writer, (Ibid., pp. 118–125), and those seeking more detailed information are referred to the above-cited volume.

1.—A. (?) GRANULOSUS, James, 1872.

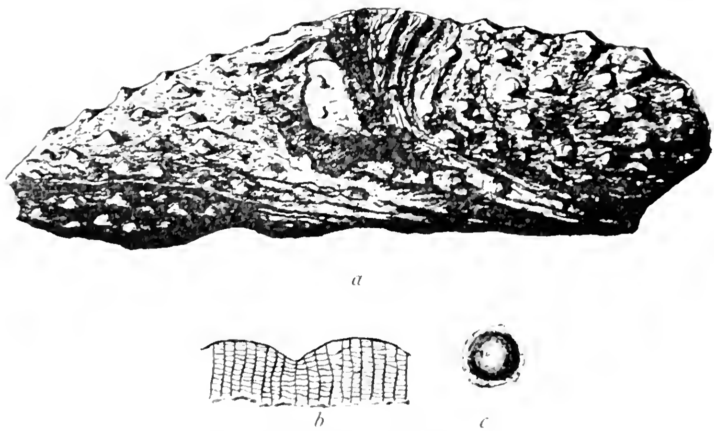


FIG. 9 — *Alveolites* [?] *granulosus*, James — *a*, type specimen reduced one-half; (T. Holm, del.); *b*, corallites enlarged; *c*, monticule (original).

Corallum massive, irregular in form, apparently built up of successive layers, variable in thickness, 1 line to ½ inch thick, or more, with apparently solid interlaminar spaces; corallites very thin walled, 3 or 4 in one line; groups of corallites sometimes radiating from different points, growing irregularly, at various angles, short or long, and curving in different directions; surface covered with granules, often with monticules from ¼ to ½ an inch apart, and elevated 1 or 2 lines; calices apparently irregular, crescentric, oval or triangular; tabulæ present. (Cat. Foss. Cin. Group, 1872, p. 2.)

Locality.—Warren and Clinton Counties, Ohio.

Remarks.—This is a peculiar form, and while the type specimen seems to be massive, it has some appearance of being made up of a number of masses which may have a central nucleus. The weathered edges show the corallites to be complete and with rather numerous tabulæ. The surface shows only granules between quite large monticules, and no clearly defined openings.

Genus 2.—PROTARÆA, Ed. and Haime, 1851.

"Corallum incrusting; walls simple, polygonal, bearing at the angles of a majority of the calices small projections; calices shallow, septa less trabeculate than in a majority of the *Poritides;* margin dentate, the innermost teeth looking like a small columella, no pales." (Mon. des Polyp. Foss. des Terr. Palæoz., Archives du Mus. d' Hist. Nat., Paris, 1851, p. 208.)

Remarks.—The above is the description given by Edwards and Haime for a coral described by Hall as *Porites* (?) *vetusta.* (Pal. of N. Y., vol. 1, 1847, p. 71.) I have been unable to find any additions to it by later writers. Only one species, with a possible variety, is known.

1.—P. VETUSTA, Hall, 1847.

"Corallum expanding so as to form a very thin crust, fixed, ordinarily, upon shells of brachiopods, and from which its shape is derived; calices polygonal, somewhat unequal, shallow; walls simple, moderately thick, and often showing at their angles small, column-like prolongations, such as are seen in *Stylocœnia;* 12 septa, alternating, somewhat unequal, rather thick outside, slightly prominent, and forming crenulations upon the wall, free at the margin, dentate, thinner within, where the teeth are much finer, and simulate in the center a columella; papillæ somewhat irregular; calices 1½ mm. to 2 mm. in size." (Ed. and Haime, Ibid., pp. 208–209.) (*Porites* (?) *vetusta*, Hall, 1847.)

Locality.—Oxford, Cincinnati, etc., Ohio.

Remarks.—The above is a free translation of Edwards and Haime's description. The species is also described in the Ohio Palæontology, vol. 2, p. 221. The original description of Hall, which is meager, is as follows: "A sub-hemispheric

coral, composed of irregular concentric laminæ; cells vertical to the laminæ; openings upon the surface nearly circular, with internal vertical lamellæ, which reach one-half way to the center." (Pal. of N. Y., 1847, vol. 1, p. 71.) The form described by Edwards and Haime as *Protaræa verneuili* (l. c. p. 209) does not show any characters sufficient to separate it, even as a variety. The description is as follows: "Corallum forming a convex, elevated mass; calices polygonal, somewhat unequal, separated by walls that are rather thin, and show at their angles small, slender columns; a score of the septa somewhat unequal, rather fine; size of the calices three mm. in diameter.—Alexanderville, Ohio."

Genus 3.—Calapœcia, Billings, 1865.

"Corallum composite, forming hemispherical or sub-spherical colonies; corallites slender, tubular, perforated as in *Favosites*, and with their outside striated by imperfectly developed costæ; radiating septa (in the species at present known), about twenty-four; tabulæ thin, and apparently, in some instances, not complete. When the corallites are not in contact, the space between them is filled with a variously formed vesicular tissue. This genus resembles *Heliolites*, but differs therefrom in having double the number of septa and the walls perforated." (Canad. Naturalist, 2d ser., vol. 2, 1865, p. 425). (*Columnopora* Nicholson, Geol. Mag. new ser., vol. 1, 1874, p. 253; *Houghtonia* Rominger, Foss. Cor. Michigan, 1876, p. 17.)

Remarks.—For a discussion of the affinities of this genus see Nicholson's "Palæozoic Tabulate Corals," 1879, pp. 159–164. Since that volume was written Dr. Nicholson has abandoned his genus in favor of that given above. (See Manual of Palæontology, vol. 1, 1889, p. 317.)

1.—C. cribriformis, Nicholson, 1874.

Corallum massive, hemispheric or pyriform, varying from ten lines to six inches in diameter, and from eight lines to three inches or more in height; corallites spreading from base of attachment, polygonal, generally in close contact and the walls thick and fused together; occasionally sub-circular,

partially separated by interspaces toward their mouths; calices rounded or polygonal, about 1½ lines in diameter, often with smaller ones intercalated, the margins thick and crenulated by the septa; septa about twenty, more or less, forming strong longitudinal ridges passing only a short distance inward; mural pores large, oval, arranged in rows between the septa, separated generally by a space less than their own diameter; tabulæ numerous, complete, flexuous, often uniting with one another, about eight in the space of one line. (Geol. Mag., new ser., vol. 1, 1874, p. 253.) (*Columnopora cribriformis*, Nicholson.)

Locality.—Cincinnati, O.

Remarks.—As above noted, this species was originally described as a *Columnopora*, and it has been generally placed in this genus. Dr. Nicholson has discarded his name in favor of the older one, *Calapœcia*.

Sub-class.—ALCYONARIA.

This sub-class is characterized by the possession of "polypes with eight pinnately fringed tentacles, the mesenteries and intermesenteric chambers being also eight in number. The corallum is usually sclerobasic or spicular, or formed of both an axial sclerobasis and detached spicules. In other types, the polypes composing the colony may be provided with separate thecæ."* The eight tentacles and eight mesenteries chiefly distinguish the sub-class from the *Zoantharia*. The corallum is compound and variable in form, being branching, linear, discoid, frondescent, etc., either fixed by a root-like process or floating free. The corallites are tubular and the tabulæ well developed.

There are numerous living and comparatively few fossil genera, at least in our section. Indeed, there are but two occurring, so far as known, in the Cincinnati Group in Ohio. These have been referred to separate families, and constitute the typical genera. They are *Heliolites* placed in the *Heliolitidæ* and *Tetradium* in the *Tetradiidæ*. We give here the generic and not the family characters. *Heliolites* has one species, and *Tetradium* two or three in our section.

*Nicholson, Manual of Palæon., vol. 1, 1889, p. 324.

Genus 1.—HELIOLITES (Guettard) Dana, 1846.

Corallum spheroidal, pyriform, hemispherical, or rarely ramose, composed of numerous closely contiguous corallites, divisible into two series; larger corallites cylindrical, comparatively few, with twelve lamellar infoldings of the wall, of the nature of pseudo-septa, which fall short of the axis of the visceral chamber; small corallites completely investing the larger ones, more or less polygonal, with distinct walls, completely amalgamated with one another and with the walls of the larger tubes, but not known to be provided with apertures allowing lateral communication; small tubes without septa, but with numerous straight and complete tabulæ, similar but less numerous ones being found in the larger tubes; no columella. (Mém., vol. 3, p. 454, pl. 22, Figs. 13, 14; Dana, U. S. Exploring Exped., vol. 8, *Zoophytes*, 1846, p. 541; Nicholson, Pal. Tab. Cor., 1879, p. 243.)

Remarks.—As noted above, the generic name appears to have been first used by Guettard, and was adopted by Dana in 1846. His description is quite meager, and therefore the more complete one given above has been taken from Nicholson.

1.—H. SHEPARDI, James, 1878.

Corallum hemispheric or discoid, from one-half an inch to an inch in diameter; cell apertures one-half a line to a line in diameter, generally two or more lines apart, sometimes only one line; margins thin, little, or not at all elevated above the surface; septa twelve, well developed; spaces between the corallites thickly set with pit-like markings (cells); base of corallum flat, convex, or with a groove between the outer edge and a saucer-like depression in the center; internal structure unknown. (The Palæontologist, No. 1, July 2, 1878, p. 2.)

Locality.—Brush Creek, Adams Co, O.

Remarks.—It is to be regretted that it is impossible to figure this species. Only four specimens were known to Mr. James, and these, together with a description, were deposited with the publication committee of a scientific society, and have never been seen since. The publication of the description in

this place may lead to the discovery or identification of other specimens.

Genus 2.—TETRADIUM, Dana, 1846.

Corallum massive, composed of long, prismatic and closely contiguous corallites, without mural pores; septa distinct, few, generally four, short, not reaching to the center of the visceral chamber, appearing like inflections of the wall; calices generally petaloid; tabulæ numerous, complete; increase apparently by fission of old tubes. (U. S. Explor. Exped., vol. 8, *Zoophytes*, 1846, p. 701; Nicholson, Pal. Tab. Cor., 1879, p. 231.)

Remarks.—The above is Nicholson's description of the genus. That given by Dana, although short, covers the main points. It is as follows: "Corallum massive, consisting of four-sided tubes, and cells with very thin septa or parietes; cells stellate, with four narrow lamellæ." Safford made the following remarks later on: (Am. Jour. Science, 2d ser., vol. 22, 1856, p. 236.) "The tubes in the different species vary from ¼ of a line to nearly 1 line in breadth; they are very long, and are most frequently united throughout laterally, forming massive coralla, resembling, more or less, those of *Favosites* and *Chætetes;* sometimes, however, they are united in a single intersecting series, as in *Halysites catenulata*, Linn.; not unfrequently, too, the tubes are isolated, or only united at irregular intervals, thus forming loose fasciculated coralla, resembling certain forms of *Syringopora*."

1.—T. FIBRATUM, Safford, 1856.

"Coralla massive, hemispherical or flattened hemispherical, composed of diverging tubes; cell tubes four-sided, with thin and slightly rugose walls; the four lamellæ distinct, nearly reaching the center of the tubes; breadth of full-grown tubes usually about, or but little more than ½ a line, varying occasionally from ⅓ to ¾ of a line; transverse septa usually absent; a few have been seen in one specimen, which were about twice the breadth of a tube apart." (Am. Jour. Sci., 2d ser., vol. 22, 1856, p. 237.)

Locality.—Oxford, Ohio, and other places in the upper beds of the group.

Remarks.—This species frequently forms masses of considerable size, and when weathered shows long parallel tubes, like organ pipes on a small scale.

2.—T. MINUS, Safford, 1856.

Corallum massive, hemispherical or amorphous, composed of slender, closely approximated corallites diverging from an imaginary axis; corallites sometimes 3 inches long, about 1/3 to 1/4 of a line wide, the walls tolerably thick and four or five-sided; septa 4, imperfectly preserved and often detected with difficulty; tabulæ well developed, complete and remote, 5 or 6 to a line. (Ibid., p. 238; Nicholson, Pal. of Ohio, vol. 2, 1875, p. 222.)

Locality.—Cincinnati, Lebanon, Waynesville, etc, Ohio.

Remarks.—The description given of this species by Safford is very meager, consisting of the statement that the specimens are generally small, the tubes 1/4 to 1/3 of a line broad, regular or irregular, generally four-sided, and with the lamellæ as in *T. fibratum.* We have, therefore, given the above description as printed in the Palæontology of Ohio.

3.—T. COLUMNARE, Hall, 1847.

Corallum massive, a foot or more in diameter, hemispherical or sub-globose, consisting of a series of parallel or diverging polygonal tubes; tubes four or five-sided, simple, without visible transverse dissepiments or connecting pores; interior of cells apparently rugose or denticulate. (*Chætetes columnaris,* Hall, Pal. of N. Y., 1847, vol. 1, p. 68.)

Locality.—Upper part of Cincinnati Group.

Remarks.—This species, originally described as a species of *Chætetes,* is recorded by Ulrich (Cat. Foss. Cin. Gr., 1880,) as occurring in the upper part of the Group. While it differs from the two other species in its general appearance and mode of growth, it seems to belong to the present genus, where it was, in fact, placed by Safford as long ago as 1856. (l. c., p. 237.) It has the characteristic square tubes, and, while the cruciform character is not well marked, there are indications of indentations of the walls in well-preserved specimens.

A fourth species is given by Ulrich, *T.* (*Phytopsis*) *cellulosum*, Hall, but this is evidently a form belonging to a lower horizon than the Cincinnati Group.

Sub-class.—MONTICULIPOROIDEA.

A group of fossils presenting a great diversity of forms, known only from Paleozoic formations and occurring mainly in the Lower Silurian; corallum varying from massive to discoid, laminar, ramose or parasitic, and made up of corallites contiguous throughout their entire length, but each possessing a distinct wall; mural pores absent; spiniform corallites frequently present about the calices and usually at the angles of junction of the corallites; cells all of the same size or in two sets, one large and one small; tabulæ generally present, complete and straight, or incomplete and curved; an epithecal membrane sometimes present and the cell openings frequently closed by opercula.

As the soft parts of the animals are entirely unknown, nothing can be said about their structure. As here considered there is but one genus, with three sub-genera. Some authors have divided the genus *Monticulipora* into five sub-genera, and consider the three here placed as sub-genera, viz., *Dekayia*, *Fistulipora* and *Constellaria*, as distinct. The five sub-genera given by Nicholson and other conservative authors are *Heterotrypa*, *Diplotrypa*, *Monotrypa*, *Prasopora* and *Peronopora*. Others have coined a large number of names that may and may not be considered valid in the future. With that we are not here concerned.

Genus 1.—MONTICULIPORA, D'Orbigny, 1850.

Corallum variable in shape, massive, ramose, laminar, frondescent, incrusting, or assuming a certain peculiar form; attached or floating free; composed of numerous tubular corallites, the walls not amalgamated with each other, and without pores, tubes mostly of two kinds, one, (interstitial) smaller than the other, and differing in internal features; interior of the tubes with few or many complete tabulæ, or diaphragms, or more or less vesicular (in sub-genus FISTULIPORA); the interstitial cells more closely tabulate than the

larger ones, and sometimes so numerous as to completely isolate the large tubes from one another (in sub-genus FISTULIPORA); the apertures of the cells generally straight, sometimes more or less oblique, varying in shape from circular, oval, hexagonal or polygonal, to square or rhombic; surface often showing at intervals areas occupied by corallites larger or smaller than the average; if elevated above the surface known as "monticules," and if on or below it, as "maculæ;" sometimes forming (in sub-genus CONSTELLARIA), star-shaped elevations, more or less thickly scattered over the surface; spiniform corallites more or less numerous, placed either at the angles, on the edges of the cells, or, at times, projecting into the cell cavity; sometimes (in sub-genus DEKAYIA), projecting above the surface as conspicuous blunt spines. (Prodrome de Paleont., tome 1, 1850, p. 25; Nicholson, Pal. Tab. Corals, 1879, p. 269; The Genus Montic., 1881, p. 30 *et seq.*)

Remarks.—The above description has been purposely made broad enough to cover the many genera that have, from time to time, been published. The reasons for this are more fully set forth in another place,* to which the student is referred. Attention is also called to Nicholson's "The Genus Monticulipora" for a very full exposition of the features of the genus and descriptions of many species. In the references to the species given below, generally only the original place of publication will be cited.

The genus is divided into six groups, founded on the external form of the corallum. While this may be considered an artificial arrangement, it is, at the same time, believed to be one more useful to the student than what might be termed a natural arrangement based upon internal structure. The groups are: I. *Massive;* II. *Discoid;* III. *Dendroid* or *Ramose;* IV. *Laminar* or *Frondescent;* V. *Incrusting* or *Parasitic;* VI. Species imitating foreign bodies. Each of these groups will be separately considered.

*On the Monticuliporoid Corals of the Cincinnati Group, with a critical revision of the species. By U. P. James and Joseph F. James. Jour. Cin. Soc. Nat. Hist., vol. 10, pp. 118-141.

GROUP I.—*Massive:* Free, or attached at one point or by the whole of the base; more or less spheriodal, globose or massive.

a. Surface smooth; corallum massive.......... 1
Corallum free, spheriodal...................... 2
b. Surface not smooth; massive, with monticules...... 3
Spheriodal, nodulated......................... 1

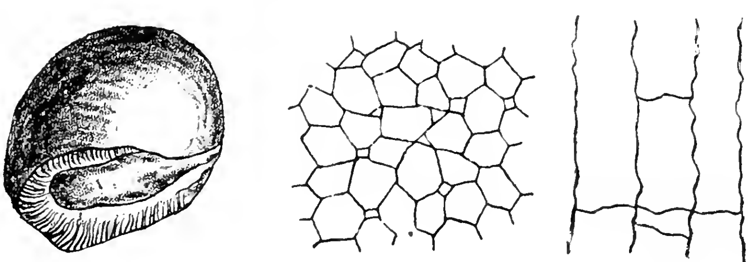
1.—M. UNDULATA, Nicholson, 1875.

Corallum forming large, lobed or laterally indented masses, with a maximum diameter of four inches and a height of about two inches, the upper surface nearly flat; corallites thin walled, angular and prismatic; calices sub-equal, with occasional clusters of six or more, forming small patches, which are faintly or not at all raised above the general surface; small corallites sometimes present at the angles of junction of the larger tubes; tabulæ few, complete, placed at corresponding levels in contiguous tubes. (Geol. Mag., decade 2, vol. 2, 1875, p. 176.)

Locality.—Ontario.

Remarks.—This form, as far as at present known, has only been found in the Trenton of Canada. A small hemispherical or spheroidal form occurring in the Cincinnati Group has been placed here by Dr. Nicholson, without a special name. This is described below under a varietal name. The above description is given so that the species may be recognized in case it be found in our region.

var. HEMISPHERICA, n. var.



a *b* *c*

FIG. 10.—*Monticulipora undulata*, var. *hemispherica*, n. var. *a* corallum, nat. size; *b* tangential section x 18; *c* longitudinal section x 18. (After Nicholson.)

Corallum rounded or irregularly spheroidal, generally 1 to 1½ inches in diameter, and sometimes growing around the stem of a crinoid; calices not observed on the exterior; corallites resembling the type (*undulata*) thin walled, prismatic, with occasional smaller cells placed at the angles; tabulæ few and remote. (See Nicholson, Genus Montic., 1879, p. 173.)

Locality.—Hudson River group of various places in Ontario.

Remarks.—In a previous paper by the author in connection with U. P. James* this variety was considered the same as *M. turbinata*, James. It seems evident now that this disposition is not a tenable one. It differs greatly externally from *M. undulata*, and resembles *M. turbinata*. Internally it resembles the former and differs from the latter. The figure is copied from Dr. Nicholson's monograph.

2.—M. TURBINATA, U. P. James, 1878.

Corallum free, forming globular, pear-shaped or irregularly rounded masses, from one quarter of an inch to an inch or more in diameter; surface smooth; calices polygonal or sub-circular, sub-equal, sometimes larger at the base; maculæ consisting of groups of six or more slightly larger calices scattered over, and only a little or not all raised above the surface; a few minute tubes wedged in at the angles of junction of some of the larger tubes; walls shown, in fractured specimens, to be strongly wrinkled; tabulæ few in number. (The Palæontologist, No. 2, Sept. 14, 1878, p. 11.) (*Chætetes subglobosa*, Ulrich, Jour. Cin. Soc. Nat. Hist., (Feb., 1880,) vol. 2, p. 129.)

Locality.—Cincinnati and Batavia, Ohio, and Covington, Kentucky.

Remarks.—As noted in a previous paper† this species was described in 1878 as *Chætetes turbinatum.* Subsequently (February, 1880), Mr. Ulrich's name of *C. subglobosus* was published. It is an obvious synoym of the present species.

3.—M. FILIASA, D'Orbigny, 1850.

"Corallum mainly fixed on shells, the surface very strongly convex, presenting small, round monticules, sub-conical, a few

*Jour. Cin. Soc. Nat. Hist., vol. 10, p. 161.

†Jour. Cin. Soc. Nat. Hist., vol. 10, p. 161.

prominent, scarcely larger than 2 mm., and distant from each other by double their diameter; the largest calices on certain of the monticules are scarcely ¼ or ⅓ mm. broad." (Prod. de Paleont., 1850, vol. 1, p. 25. Edwards and Haime, Poly. Foss. des Ter. Palæoz. Archives du Mus. d' Hist. Nat., 1851, vol. 5, p. 266.)

Locality.—Cincinnati, Oxford, etc., Ohio; Madison, Indiana; Covington, Kentucky, etc.

Remarks.—This is an illy-defined form. It was named and described or characterized in 1850 in a single line by D'Orbigny. In 1851 Edwards and Haime re-described and illustrated it, and this description is quoted above. The corallites are thin-walled and sub-equal, without interstitial cells. Specimens are found from 4 to 5 inches in diameter attached to shells of *Ambonychia*. I have seen one of these in which the corallum extended an inch beyond the shell upon which it grew, and the bases of the corallites were plainly visible. The upper surface showed numerous elevations that seemed almost like the beginnings of branches. The tabulæ of the cells are complete and horizontal, and may be close or remote, according to the point at which the section has been made.

4.—M. IRREGULARIS, Ulrich, 1880.

Corallum small, about ¾ of an inch in diameter, spheroidal, and apparently free; surface nearly smooth or covered with nodules; monticules none; corallites of one kind only, thin-walled, polygonal, radiating outward from one point to all parts of the surface; tabulæ almost obsolete, although complete, transverse partitions are occasionally developed, generally at corresponding levels in contiguous tubes. (Jour. Cin. Soc. Nat. Hist., vol. 2, (Feb., 1880,) p. 129; Nicholson, Genus Montic., 1881, p. 177.)

Locality.—Hamilton, Morrow, etc., Ohio.

Remarks.—This species is similar to *M. turbinata* in shape, but it is easily separated by the nodulated surface and smaller corallites. In the collection of the late Mr. U. P. James is a specimen with a conspicuous pointed base and a puff-ball like form. Another has six conspicuous nodulations, the surface of these being entirely smooth.

[TO BE CONTINUED.]

MICROSCOPICAL STUDY OF OHIO LIMESTONES.

By G. Perry Grimsley, M. A., Columbus, Ohio.

Although the general characteristics of the Ohio limestones have been carefully investigated, both from an economical and paleontological point of view, no extended study has as yet been made of their microscopical structure. That we may have a complete knowledge of the history and structure of limestones, this part of the study should by no means be overlooked.

The application of the microscope to the examination of rocks in thin sections is a result of experiments of men now living, and, as a result of their labors, a new branch of science has come into existence known as *Microscopical Petrography*.

For a couple of centuries men had been experimenting along this line, but these were but the glimmering rays in the darkness and perplexity of mineral study, heralding the coming of a brighter light, which would reveal a new and vast field for experiment and thought.

The year 1850 may be said to mark the beginning of *Modern Petrography*, when Mr. H. C. Sorby, of England, applied the microscope to the examination of thin rock sections. But it was in Germany that the greatest progress has been made, and now the leader in the new science is the German investigator, Rosenbusch, whose first great work appeared in 1873. This soon attracted workers from all parts of the world. American students brought the science across the water, and now we have the names of Williams, Iddings, Cross, Wadsworth, Adams and other workers connected with the science. Such is a brief account of the introduction of the microscope into geological work.

The aim of the present paper is to note the structure, as revealed by the microscope, of the great limestones of the Ohio scale in their geological order, devoting especial atten-

tion to the waterlime group, which is regarded by some as fossiliferous, and by others unfossiliferous.

Our Ohio column begins with the

LOWER SILURIAN SERIES.

The remnants of the old Silurian or Ordovician Sea in Ohio occupy about a dozen counties in the southwestern corner of the State. The beds are highly fossiliferous, containing large numbers of brachiopods, lamellibranchs, trilobites and crinoids, so that the region forms the best collecting ground in the State for the paleontologist. This is the oldest formation of the geological scale of the State, and its life and general microscopical character have been studied with greater care and completeness than any other group, but its microscopical characters have never been investigated.

Selecting carefully a dozen slides, and examining them under the microscope, we find revealed to the eye monticuliporoids, with the species *mammulata* and *ramosa* especially abundant; the Trenton tentaculite; the spiny head shield of acidaspis; crinoid joints very numerous; and with these fragments of shells, with their characteristic structure, of these only one was perfect enough for identification—the small *Cyclora minuta*.

Numerous crystals of calcite or dolomite occur, showing the characteristic rhombohedral cleavage. It is impossible to separate these two minerals under the microscope, but, as this is a magnesian limestone, the crystals might be termed dolomite.

A very fine section of *Ptilodictya fenestelliformis* was observed, which did not appear before the grinding, thus showing, in a slight way at least, the utility of microscopic examination of rocks.

The predominant structure consists of shells and coral remains, either entire or broken. These shell fragments, though too small for identification, are yet useful to show the minute shell structure, appearing under a low power as mere dots, but under a high power are resolved into obscure wavy lines and circles. These various structures found show the diversity of life in the old seas, and prove that, while brachiopods and polyzoans form the greater part of the preserved

life, they were not the only denizens of that far-away time. The greater part of the limestone is made from the shells and corals, both in their original form, and secondarily as a result of solution. The matter in solution was partly lost, partly deposited in an amorphous form, making a cement to hold the fragments together, and partly in a crystallized form, as calcite or dolomite, although the latter is probably a result of a replacement of the calcium molecule by the magnesian.

The limestone, then, consists of shell and coral fragments of varying size, associated with other forms of fossil life, imbedded in a semi-crystalline matrix composed of still finer fragments, resulting from solution and pressure, firmly cemented together by carbonate of lime, resulting from the solution of shells and corals.

Looking back into that far-away epoch, one can picture the conditions and changes which aided the formation of these limestones. The molluscan animals and polyzoans inhabited the Ordovician Sea in great numbers, and, dying, sank to the bottom, where they were gradually consolidated under moderate pressure and by the action of the water into masses of soft limestone, growing and undergoing changes until the land was elevated and the sea pushed southward. This change was very gradual, for the rocks show no effects of metamorphism or of great disturbance. Many of these shell masses are yet unconsolidated, and are exact counterparts of the *coquina*, or shell rock, of the Florida coast of to-day. Their existence was a quiet one, much like the condition of the Mexican Gulf of the present time; the changes were few and slow, as if the end had been reached, and henceforth there was to be no change, but underneath flowed the quiet current of progressive evolution, whose work is not visible in a day or year, but ages. And, no doubt, this remnant of the old Silurian Gulf, which we know as the Mexican Gulf, will grow less by new additions much like these old, destined at last to unite completely the two continents, and add a new series to the geological scale of the future. The changes there to-day, slow as they seem to be, are no slower than the changes in the old Silurian Gulf, which geological exploration and study seem to have proven to be nothing more or less than the ancestor of the Southern Gulf.

Ascending the geological column of the State, we next find the

CLINTON GROUP,

A narrow fringe forming the boundary between the lower Silurian and Niagara foundations. The formation is of small extent, and in composition is almost a pure carbonate of lime. The limestone is highly fossiliferous, consisting of brachiopods, corals, and crinoids.

This series in Ohio has been a disputed one, many contending it is only a part of the Niagara, but its invariably lighter color, pure composition, and distinct fossils, many of which are identical with the Clinton of other States, indicate a new and distinct series.

Thin sections show many fragments of *Clathropora*, probably the *clintonensis*, a few fragments of Favosites, with other corals and a few shells. One layer of a light brown color, probably colored by iron, is quite compact, semi-crystalline, and only sparingly fossiliferous. Another form of the rock is of a light color, crystalline, and made up almost entirely of fragments of crinoids, being a typical crinoidal limestone. The crystals making up the remainder of the rock are calcite. Almost all of the sections contain some fragments of crinoids, and this was an age of crinoids, in distinction from the lower group. On account of the beds of iron ore found at this horizon, and the great yield of gas in the newer fields, it would be inferred that vegetable life was abundant at this time, but there are no definite proofs of the fact. The diversity of life continued into this period, but many of the old forms have passed away and new ones have taken their place. The limestone is more compact, harder and more cystalline, almost a marble in texture, and is a very pure carbonate of lime. The Clinton period in Ohio was a brief one, and was followed by the more extensive

NIAGARA SERIES,

Consisting of shales and a magnesian limestone, with considerable fossil life, which is mainly preserved in the form of internal casts. The characteristic forms being *Pentamerus*, *Trimerella*, *Monomerella*, and *Atrypa*.

The area extends over a large portion of Southwestern

Ohio, and a smaller area in the northern part of the State. This marks the second great limestone formation in the scale, and doubtless was deposited in the Niagara Sea as a pure carbonate of lime, but, by a slow dolomitic replacement, was changed into a fairly pure dolomite, and now is used quite extensively as a source of magnesian lime. From these facts it will be seen that a microscopical study will not be as satisfactory as heretofore, for but little original fossil matter is left. The dolomite crystals are very apt to break out in the process of grinding, thus leaving open, irregular spaces through the section. Fossil structure is seen in very small amount, consisting of a few fragments of crinoids, which seem to have withstood the change, and a few small fragments of coral of the form *Clathropora*. The shells are completely obliterated, and a careful observation has failed to reveal the slightest trace of such structure.

The casts indicate an abundance of life, so we would infer that the Ohio deposit has had bad luck, probably shut off from the ocean to form an evaporating basin, which greatly aided the change from a limestone, like those before it, into the compact, almost structureless, rock we now find. Doubtless there was here a great diversity of life, of which even the record has perished.

All the formations studied thus far have proven fossiliferous to a high degree, life seemed to be abundant, but now we come to a break, to a series which seems to be unfossiliferous, the

LOWER HELDERBERG FORMATION,

Or waterlime group of Ohio, which consists of a magnesian limestone, inclosing at a number of points large beds of rock salt and gypsum. This formation covers two dozen counties of the State, and the limestone contains a notable percentage of bituminous matter, appearing in streaks through the rock, which accounts for the odor of petroleum when it is struck with the hammer.

It has long been regarded unfossiliferous, with the exception of a few casts, the most common being the small coffee grain fossil, *Leperditia alta*. The explanation which has been given is based on the existence of the beds of salt and gypsum, many regarding this portion of the geological series as the

remnant of an old isolated sea basin, which slowly evaporated. The water, becoming salty and bitter, would destroy all life which happened to be present, and on the bottom of this inland sea would be deposited a dolomitic limestone, but no true carbonate, so that all traces of life would be destroyed.

In 1880, some blocks of this limestone were polished for the National Museum at Washington, and it was stated that "one polished upon the surface parallel to the plane of stratification showed a fossil bryozoan, and thus proved it was fossiliferous."

This structure does resemble somewhat a fossil, but Mr. C. D. Walcott, paleontologist of the U. S. Survey, could see in it no proof for calling the limestone fossiliferous. In twenty-five sections of this stone, taken from different parts of the series, I could find no distinct fossil structure.

The rock is compact, containing numerous black lines of bituminous matter, which simulate coralline structure, and all very confusing. With a little imagination one can trace out *hydrocorallines* and even tube and radiating structure of *Cœnostroma*, but yet there is nothing definite—nothing that can be regarded as fossil structure beyond doubt. The bitumen has a peculiar regular parallel and radial arrangement, and it suggests that perhaps there is a replacement of the old hydrocoralline mass by bitumen, so that we have, as it were, a bituminous cast.

After careful study and thought, it seems to me that this sea must have contained a considerable amount of life, but that this basin was cut off from the main part, then, by its evaporation, destroyed the life; but the limestone was deposited as a carbonate, soon to be replaced by the various magnesian salts, so that the fossil shell and coral were soon replaced, and only casts remained; then, by consolidation through pressure, even these casts were destroyed. This pressure is shown by occurrence of small pressure columns in the limestone. We are forced, then, to say that the *Helderberg limestone of Ohio is very sparingly fossiliferous*, even in microscopic sections, but we can not say *the Helderberg sea in Ohio was without life.*

The last great limestone we find in the Ohio scale is the

DEVONIAN,

or Corniferous, extending, as a narrow strip, 8–20 miles in width, through central portion of the State. The limestone is quite a pure carbonate, abundantly fossiliferous, containing brachiopods and reef building corals in great abundance. It is here that we find the first abundant plant and fish life preserved.

At Columbus, probably, the best development is to be found. The upper portion is shaly, with very few fossils, and these are mainly fish remains; below this stratum comes a brown and white chert, which is not acted upon by acids. The fossils in this chert are very finely preserved, even the delicate markings coming distinctly to view. Below this comes the bone bed, a comparatively thin layer made up of the teeth and remains of fish, while below this lies the great mass of limestone used for lime and building purposes. The microscope reveals many interesting and puzzling fossil forms.

The brown chert is very compact, but contains a few fragments of shells, crinoid joints, and a number of light spaces, highly crystalline, whose origin is to be traced to the replacement of organic life by crystalline matter.

The white chert is more abundantly fossiliferous, even to the naked eye, but under the microscope it is one mass of fossil life, crinoid stems being especially numerous. There are a number of forms belonging to the group *Porifera*, or the order of sponges, sponge spicules being found through the rock. This is the first time they have been reported from the Ohio Devonian. The chert has an organic origin, and we have a good example of a silica replacement of limestone. We can even make a series of gradations to this end; starting with the limestone, then taking the white chert, abundantly fossiliferous in many places, then the brown chert, which is only slightly fossiliferous, and I have found several specimens of a hard brown chert covered by a layer of perfect minute quartz crystals, and this again covered by chert, suggesting a still further change, due to partial solution and deposit. This accords very closely with the observations with regard to the carboniferous flints made by Dr. Hinde, of England, whereby he proves their organic origin.

The limestone proper is mainly compact and semi-crystalline,

consisting of broken shell fragments better preserved than any yet seen. Coralline structure is also shown, the lace corals especially. Crinoid stems occur in various shapes, the five-sided form being most common.

Among all the sections there can be traced a great similarity. The limestone, under the microscope, is seen to be quite uniform, and confirms the observation made in the quarries that the abundant and predominant forms are brachiopod shells. One section showed the fossil *Styliola*, a pteropod shell, which often forms whole masses of Devonian limestone, but is very rare in Ohio Devonian. This completes the second series, which is characterized by an abundance of fossil life.

The Silurian and Devonian periods have preserved to us, under favorable conditions, the great chapters of the life history of the past.

The study of the carboniferous limestones is as yet incomplete, but a number of new facts are coming to light, and certain limestones long regarded as unfossiliferous are found to contain a variety of fossil forms, only revealed by the microscope.

(ABSTRACT.

NIAGARA'S WATER POWER.

BY B. M. RICKETTS, PH. B., M. D.

Read January 3, 1893.

Niagara is in latitude 43 degrees, 16 seconds North; longitude 2 degrees and 5 seconds West from Washington, or 79 degrees and 5 seconds West from Greenwich.

The word Niagara is of Indian origin, borrowed from the language of the Iroquois, and means the "Thunder of Waters." There are five gorges of about equal depth, width and length within a radius of thirty miles of Niagara River (all to the West) showing that the river's course had as many times been changed. There is a possibility of there having been three separate falls, one above the other, when the falls first began to recede.

Over Niagara pour 58,000 barrels of water per second; 3,480,000 per minute; 208,800,000 per hour. Its sources are Lake Erie, 290 miles long, 65 miles wide, 210 feet deep; Lake Superior, 355 miles long, 160 miles wide, 1,000 feet deep; Lake Huron, 260 miles long, 100 miles wide, 1,000 feet deep; Lake Michigan, 320 miles long, 70 miles wide, 1,000 feet deep; Lake St. Clair, 49 miles long, 15 miles wide, 20 feet deep.

These lakes are the receptacle of all the surface water extending over 150,000 square miles, almost one-half of the continent. With such a supply the waterfall at Niagara is never noticeably diminished; hence the inducements offered to capitalists to utilize this immense waterfall for manufacturing purposes.

The first method of utilizing the water-power at Niagara on a large scale was by the old hydraulic canal, which commenced on the shore of the river above the falls, extending about three-quarters of a mile to its discharge place on the

high bank of the gorge below the falls. Its capacity has been overtaxed. Of the five sources of power, water occupies the second place, steam the first, wind-mills the third, animal power the fourth, the solar engine of Ericsson the fifth. Water wheels have always furnished, and still furnish, the cheapest mode of producing power at points where power is in great demand at places distant from any waterfall (and demanded also in portable form); the engine could in no wise compete with water-power.

By offering a ready and commercially practicable method of transmitting power, the modern methods of electrical, pneumatic, hydraulic and wire-rope transmission of power have enhanced the values of existing water-powers very much. Especially is this true in the case of water-powers hitherto utilized, or which were not hitherto utilized; and it is largely owing to this modern development of methods of power transmission that a beginning has been made in the utilization of some portion of this waterfall.

Now, that electric motors may be run at a distance of 125 miles from the seat of power, it can readily be seen what the result will be. Niagara being in the center of a circle 250 miles in diameter, will surely be looked upon as the greatest water-power the world can produce, and, with transmission of power at Frankfort and elsewhere, gives promise of much more work of this sort in the future.

A tunnel has been constructed, 7,600 feet long, to form the tail race to be jointly used by all the mill sites. Large tracts of land were purchased by the company within the city on the river bank.

The tunnel is for 100,000 horse-power, and is 19 feet wide and 21 feet high inside the brickwork, with which it is lined throughout. The base of the tunnel is 205 feet below the sill of the head-gate at the entrance of the main canal from the river above the falls. This represents the total fall, of which 140 feet will be available, the difference being taken up by the allowance for clearance from the wheel pits, incline of the lateral tunnels leading therefrom to the main discharge tunnel, and the incline of the latter, which is made at a grade of 36 feet to the mile. The tunnel is lined on the invert and sides a distance of 200 feet back from the discharge point

with closely fitted cast-iron plates, there being a heavy cast-iron frame at the mouth, and the tunnel is furthermore lined throughout with four courses (a total of 16 inches) of brick. The excavation was made on three different benches. The top one 9 feet high to the top of the arch, being always extended ahead of the second bench, 8 feet high, the workmen in the latter bench being covered by a flooring, over which the material excavated from the top bench was conveyed backward on the small dump-cars.

The excavation on the bottom bench, which measured 9 feet vertically to the bottom of the invert, was not commenced until the work on the other two benches had been nearly completed. After the work was well under way the rock-cutting was effected at a rapid rate, 338 feet of tunnel, averaging 14 yards to the running foot, having been excavated in 26½ days. Shaft No. 1, 2,650 feet from the portal, was sunk 206 feet, and is 10 by 20 feet in size, while shaft No. 2, of the same size and 196 feet deep, is 5,200 feet from the discharge point. One hundred and forty feet of the shafts were through hard bastard limestone, which overlays the Niagara slate or Utica shale, met with for the remaining distance, and through which the main tunnel itself was mostly made; its base, as it reached away from the river, being in Queenstowne limestone.

The largest turbine wheel now in existence is 500 horse-power. Those to be used by this company are to represent 5,000 horse-power each. The four polar dynamos, with drum armatures, will be directly connected with the shafts of the turbines, which will make 250 revolutions per minute. The cost of water-wheels, exclusive of excavation and erection, and also exclusive of pumps, compressors, and dynamos, is given at $3.90 per horse-power. The wheels are to be guaranteed at 80 per cent. efficiency, although the makers expect 85 per cent.

Contracts will be made to furnish power on the company's grounds at the falls for 24-hour days according to the following approximate scale: For 5,000 horse-power, $10.00 per horse-power; for 4,500, $10.50; for 4,000, $11.00; and $20,00 for 300 horse-power; all under this being supplied by electro-motors.

DESCRIPTION OF A NEW PHALLOID.

By A. P. Morgan.

The following new and very singular member of the Phalloideæ was first found by me nearly ten years ago.

The plate which illustrates it is a copy of one made in oil-colors, and dated June 30, 1883. On account of my scanty material and the abnormal structure of the plant, I did not venture to publish it among my North American Phalloideæ. Since that time, however, I have received specimens from Granville, Ohio, sent by Prof. C. J. Herrick, and from Syracuse, New York, and from West Goshen, Connecticut, sent by Prof. L. M. Underwood.

Being well satisfied that the plant has never before been described, and having good and sufficient evidence of its growth and very peculiar and abnormal structure, I, therefore, now proceed to describe and figure it as I understand it.

Phallogaster, Morgan, Gen., nov.

Mycelium fibrous, much branched. Peridium obovoid, consisting of two concrete layers, an inner and an outer one, rupturing irregularly. Gleba composed of numerous roundish irregular masses, or lobes of a green color, attached to the inner surface of the upper part of the peridium; spores minute, oblong, hyaline.

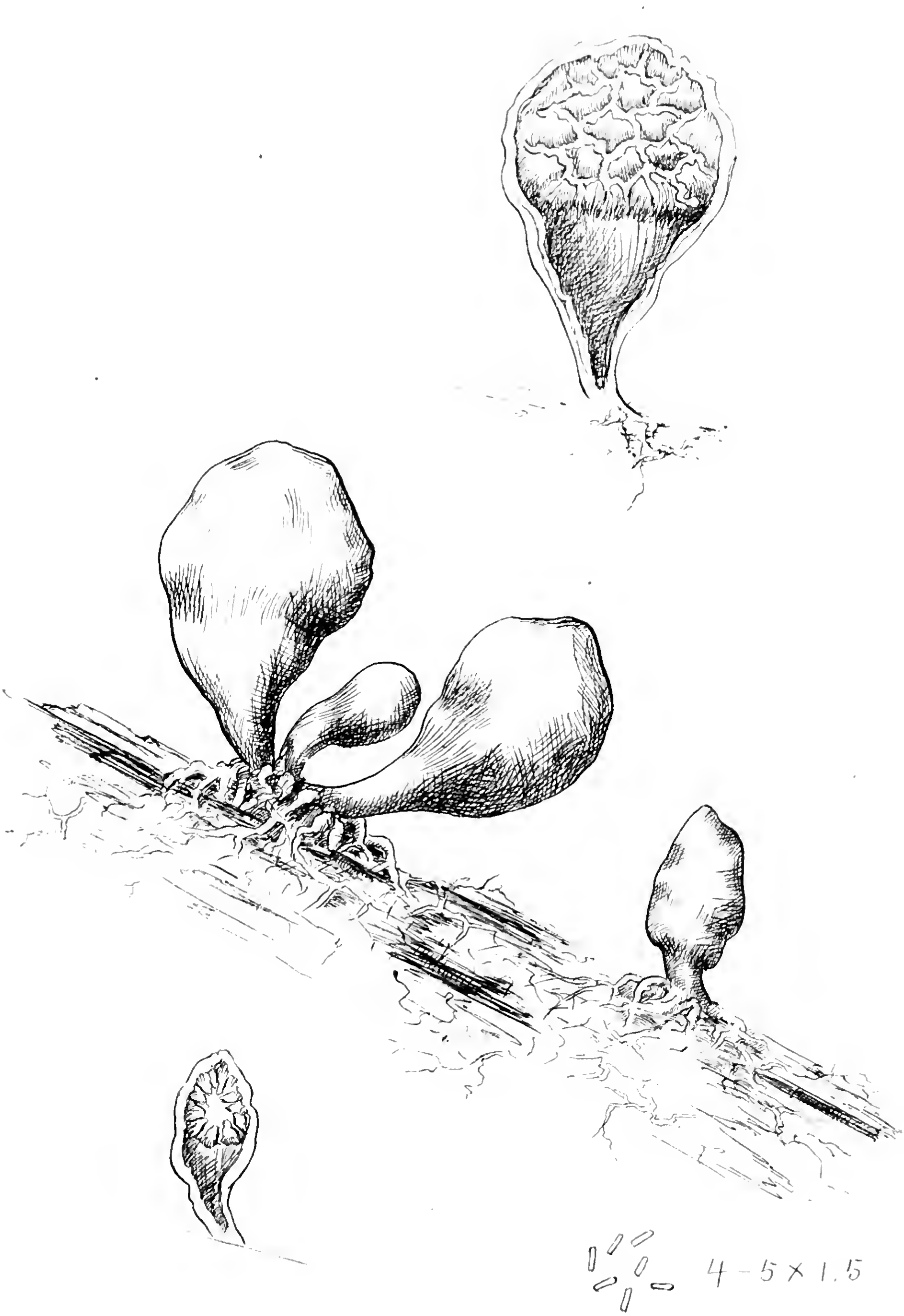
This is a remarkably abnormal member of the Phalloideæ. It does not develop an enlarged receptacle with a volva at the base, and there is no gelatinous layer between the inner and outer coats of the peridium. It forms a closer connection between the Phalloideæ and the Lycoperdaceæ than has hitherto been known.

1.—PHALLOGASTER SACCATUS, Morgan, n. sp.

Fetid, single or cæspitose, often several arising from an abundant slender, white, fibrous, branching mycelium. Peridium obovoid, usually tapering below, thick, tough-fleshy, the surface smooth and glabrous, glaucous-pink or flesh-color; rupturing by the gradual decay of the wall. The interior of the peridium is at first filled above by the gleba, below by a white floccose substance, both are transformed into mucus upon the maturity of the spores. The gleba consists of numerous green lobes, or masses, sometimes quite distinct from each other, seated on the white glairy inner wall of the peridium. Spores abundant, floating in the mucus, transparent and colorless under the microscope, linear-oblong, 4–5 x 1.5 mic.

Growing singly or in clusters of three or four attached to the same stringy mycelium, which penetrates the rotten wood of an old stick or trunk. Peridium 1–2 inches in height and ½–1 inch in diameter. I observed upon the fibers of the mycelium abundant crystals of calcium oxalate, as figured by DeBary on the mycelial strands of *Phallus caninus*.

The peculiar phalloid odor is not so powerful as in other members of the family.



Phallogaster saccatus, Morgan n. sp.

Laura V. Morgan Del.

THE HENDERSON ACHERT-KREBS LITH. CO. CINCINNATI

EXPLANATION OF PLATE III.

Fig. 1.—Licea biforis, Morgan, n. sp.

Figs. 2, 3, 4.—Diagrammatic representation of the structure of Tubulina.

Fig. 5.—Lycogola conicum, Pers., natural size.

Fig. 6.—Lycogola exigum, Morgan, n. sp., natural size.

Fig. 7.—Lycogola epidendrum, Buxb., natural size.

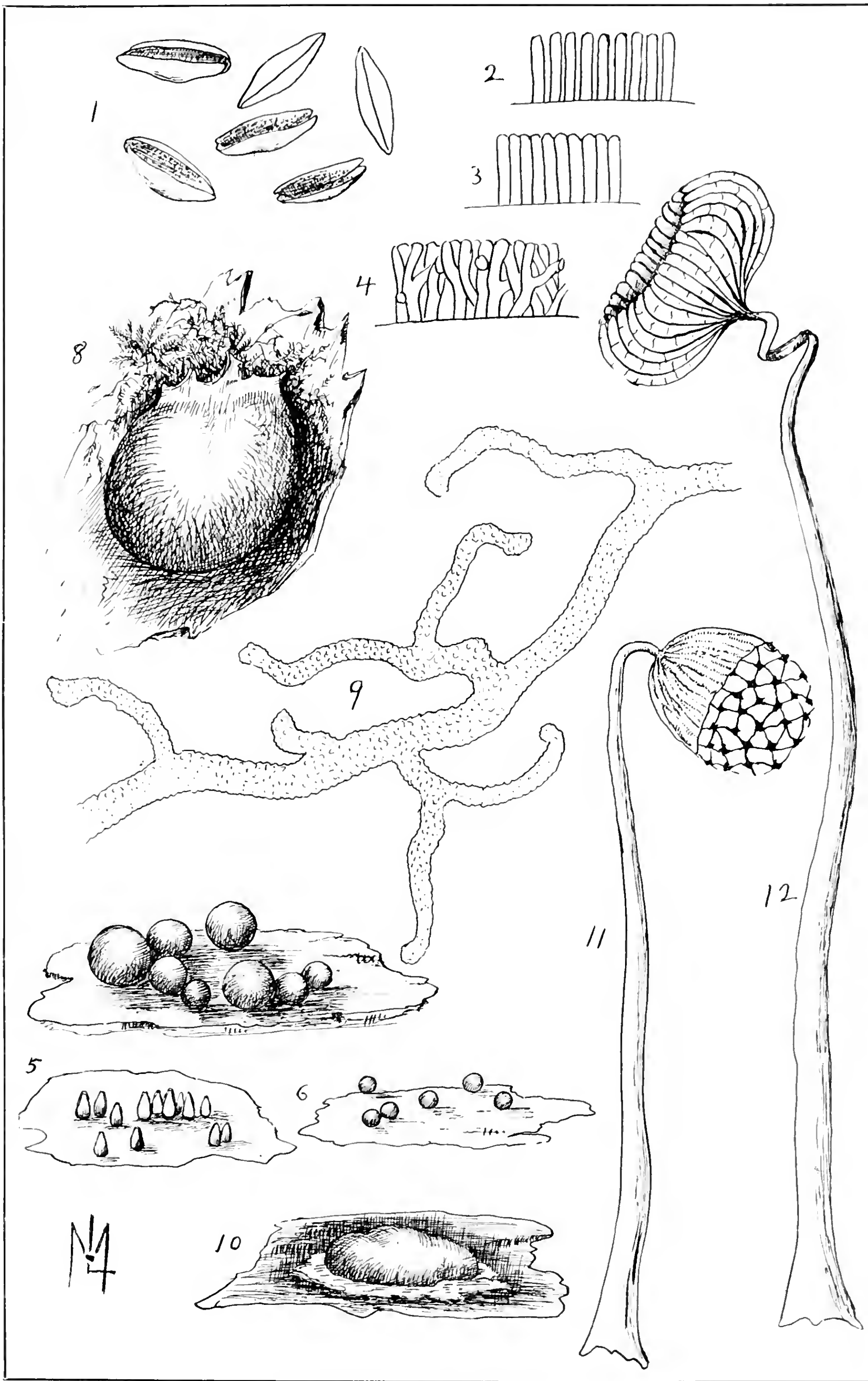
Fig. 8.—Lycogola flavofuscum, Ehr., natural size.

Fig. 9.—Portion of tubule of Lycogola flavofuscum.

Fig. 10.—Reticularia splendens, Morgan, n. sp., natural size.

Fig. 11.—Cribraria cuprea, Morgan, n. sp.

Fig. 12.—Dictydium longipes, Morgan, n. sp.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THE JOURNAL

OF THE

Cincinnati

Society of Natural History

VOLUME XVI

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THE CINCINNATI SOCIETY OF NATURAL HISTORY,

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1893-94.

Publishing Committee.

Geo. W. Harper. Chas. Dury.

Wm. Hubbell Fisher. Mrs. M. C. Morehead.

Davis L. James (Editor).

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VOLUME XVI.

THE JOURNAL

OF THE

Cincinnati Society of Natural History.

VOL. XVI. · CINCINNATI, APRIL, 1893 · NO. 1.

PROCEEDINGS.

January 3, 1893.

The regular January meeting of the Society was called to order at 8 P. M., with President Collier in the chair.

The reading of the minutes was dispensed with.

Upon motion, the applications of W. F. Howell, W. A. Eudaly and Charles Barnes were balloted on together. Receiving the necessary number of votes, they were declared duly elected to active membership.

Upon recommendation of the Executive Board, Prof. Wm. C. Gurley, Director of the Observatory of Marietta College, Marietta, Ohio, was elected to honorary membership.

The resignation of E. H. Crowell as active member was accepted.

The following papers were read by title and referred to the Publishing Committee, to-wit:

Manual of Palæontology of the Cincinnati Group. Part III. By Jos. F. James.

Observations Concerning Fort Ancient. By Selden S. Scoville.

The Myxomycetes of the Miami Valley. First Paper. By A. P. Morgan.

Dr. B. Merrill Ricketts then read a very interesting and instructive paper upon "The Utilization of Niagara's Water Power." Lantern slides were used to illustrate.

Adjourned.

March 7, 1893.

The regular March meeting of the Society was called to order, with President Collier in the chair.

The reading of the minutes was dispensed with.

The following applications for active membership were read and ordered posted, to-wit: George E. Bryan and J. C. Carpenter.

The reading of the minutes of the Executive Board was postponed.

There being no further business, the chair called upon Mr. Charles Dury, who presented a delightful paper, "Notes on Preserving Natural History Subjects." He illustrated his remarks with specimens — contrasted to show the bleaching effects of ordinary daylight — and a new superior insect case.

Adjourned.

Annual Meeting.

April 4, 1893.

The regular annual meeting of the Society was called to order at 8.08 P. M., with President Collier in the chair.

The minutes of the Society for December 6, 1892, and January 3, 1893, were read and approved.

Upon motion, the reading of the minutes of March 7, 1893, was dispensed with.

The following applications for active membership were read and ordered posted, to-wit:

Mrs. Clara D. Klemm and Albert Lawson.

George E. Bryan and J. C. Carpenter were, upon motion, balloted for together, and duly elected to active membership.

The reading of the minutes of the Executive Board was dispensed with.

Upon motion, the resignations before the Society were accepted.

The Treasurer, Mr. Davis L. James, then presented his annual report, and made some verbal explanations.

The report of the Trustees was read by Mr. Davis L. James. It was prepared by Trustee A. A. Ferris.

Upon motion, both of these reports were received, ordered filed, and the chair was instructed to appoint an Auditing

Committee to audit same. The chair appointed Messrs. Kelley, Ricketts and Collier.

On behalf of the Museum Committee, Mr. Charles Dury presented a brief report.

Mr. T. B. Collier then presented his report as Curator of Photography, showing the share the members of this section have taken in the work of the Society.

The Director of the Museum, Mr. Seth Hayes, then read his report, calling attention to the work done since his connection with the Society, and outlining the work desirable and necessary for the ensuing year.

Upon motion, the reports of the Museum Committee, Curator of Photography and Director of the Museum were received and ordered filed.

Upon motion, it was decided to proceed with the election of officers for the ensuing year.

The chair was instructed to appoint two tellers. Messrs. Davis L. James and Dr. P. M. Bigney were so appointed.

Nominations were then declared in order.

Upon request, the names of the present incumbents were read.

Mr. T. B. Collier having been nominated for re-election as President, it was decided, upon motion, that the nominations be closed, and that the Secretary cast the unanimous ballot of the Society for him. The ballot having been so cast and announced, Mr. T. B. Collier was declared elected as President.

Dr. F. W. Langdon was nominated for re-election as First Vice-President. The usual motions prevailed, and the Secretary cast the ballot of the Society, whereupon he was declared duly elected as First Vice-President.

Dr. B. Merrill Ricketts was re-nominated for Second Vice-President. The usual motions prevailing, he was duly elected.

Mr. Davis L. James was again nominated for Treasurer, and was, after the usual motions, declared elected.

Mr. T. H. Kelley was nominated to succeed himself as Secretary. His election was announced after the usual motions had prevailed.

Nominations for members of the Executive Board-at-Large being called for, it was decided, upon motion, to ballot for all nominees at once.

After the following gentlemen had been nominated, the nominations were closed by motion, to-wit: Mr. Charles Dury, Dr. A. T. Keckler, Dr. O. D. Norton and Prof. G. W. Harper.

Upon motion, the Secretary was instructed to cast the unanimous ballot of the Society for these gentlemen.

The ballot having been so cast and announced, they were declared duly elected.

Mr. A. A. Ferris was nominated to succeed himself as Trustee. After the usual motions, the Secretary cast the ballot of the Society for him. Being announced, he was declared duly elected.

Dr. M. Cassat was re-nominated as Librarian. He was duly elected, after the usual motions.

Nominations for Curators being called for, the following nominations were made, to-wit:

Curator of Geology, E. O. Ulrich.
Curator of Botany, Davis L. James.
Curator of Zoology, Charles Dury.
Curator of Anthropology, Dr. O. D. Norton.
Curator of Photography, H. J. Buntin.
Curator of Microscopy, Dr. B. M. Ricketts.
Curator of Physics, no nomination.
Curator of Chemistry, Dr. A. I. Carson.

The usual motions prevailing, the Secretary cast the unanimous ballot of the Society for these gentlemen, which was duly announced, and they were declared elected.

Several donations were presented to the Society — a complete list of which was read.

Adjourned.

DONATIONS.

Dr. F. W. Langdon, Monkey's dinner-bell or sand box tree (Hura crepitans, L.) West Indies.

Dr. O. D. Norton, Nest of Baltimore Oriole (Icterus baltimore); Sword of sword fish; Gavel made from sword of sword fish; Thermometer — testing.

Geo. H. Curtis, Guinea Corn and Milo Maize, from Kansas.

P. W. Carter, Golden Eagle (Aquila chrysaetus), shot near Stanford, Ky., Jan. 7, 1893.

Chas. Dury, Snow Owl (Nyctea nivea).

Dr. Elgar Reed, by Dr. M. Cassat, Tarantula (Tarantula apuliæ) and Trap-door Spider (Cteniza californica) and Nest, from Los Angeles, California.

Charles A. Beecher, collection from the Hawaiian Islands, consisting of plants, shells, lavas, bread stuff, vegetables, fiber, etc.

PAMPHLETS.

E. O. Ulrich, Newport, Ky., The Bryozoa of the Lower Silurian in Minnesota.

J. D. Cox, Cincinnati, Ohio, Reports of Missouri Botanical Garden for 1890, 1891 and 1892.

Geo. Frederick Kunz, New York City, Bohemian Garnets; Notes on Brookite, Octahedrite, Quartz and Ruby; The Farmington, Kansas, Aerolite; Meteoric Irons; Five New American Meteorites; Precious Stones.

E. D. Cope, Philadelphia, Phylogeny of the Vertebrata and on some points in Kinetogenesis of the limbs of Vertebrates; Crook on Saurodontidæ from Kansas; Rütemeyer on the classification of Mammalia, and on American types recently found in Switzerland; Fourth note on the Dinosauria of the Laramie, and on a new genus of Mammalia from the Laramie formation; False Elbow Joints.

REPORTS SUBMITTED AT THE ANNUAL MEETING, APRIL 4, 1893.

REPORT OF TREASURER OF THE CINCINNATI SOCIETY OF NATURAL HISTORY, FOR THE YEAR ENDING APRIL 4, 1893.

Balance on, hand, April, 1892,		$670 78
Receipts,		3,190 05
		$3,860 83
Expenditures,	$3,672 70	
Balance on hand,	188 13	
		$3,860 83

RECEIPTS.

Balance,	$670 78
Dues,	690 00
Material sold,	23 00
Journals sold,	28 50
Interest,	2,448 55
Total receipts,	$3,860 83

EXPENDITURES.

Salaries,		$1,507 17
House expenses (including postages),		333 20
Gas,		28 09
Water—Water meter and repairs,	$57 00	
Water rent,	16 66	73 66
Printing and stationery,		83 20
Journal,		343 00
Fuel,		102 50
Interest,		108 00
Museum,		418 84
Repairs,		572 42
Investment,		22 85
Lectures,		79 77
		$3,672 70
Balance on hand,		188 13

The income for the past year, as compared with last, has decreased $305.75, due largely to the smaller amount of dues collected. The collections show a falling off of $280.22. The income from investments during the year decreased $42.56.

The expenditures have increased above those of the previous year over $1,400, as follows:

Salaries,	$432 17
House expenses,	125 59
Water rent,	73 66
Repairs,	473 82
Museum,	351 84
	$1,457 08

These expenditures were necessary to put the Museum in good shape, and have been to the great advantage of the Society, and vastly increased the usefulness of the Museum to the public.

The item of $22.85 for investment, was paid to the Trustees by the Treasurer, to make up a sum wanted to invest a small balance remaining in the hands of the Trustees.

The interest on the Society's outstanding notes has been paid, with the exception of that on one note, owing to the absence of the holder from the country.

The Treasurer would respectfully call attention to the necessity of making provision to meet the notes of the Society as they mature. The first of these will be payable in two years from next June, and all of the $2,100 outstanding by March in the year following. A sinking fund should be provided for.

All of which is respectfully submitted,

DAVIS L. JAMES,
Treasurer.

TRUSTEES' REPORT.

CINCINNATI, April 4, 1893.

TO THE BOARD OF DIRECTORS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

Gentlemen — The undersigned Trustees of the Society beg leave to submit their annual report, showing the funds of the Society invested as follows:

MORTGAGES ON REAL ESTATE.

FROM.	Date.	Time.	Interest.	Par Value
Martin Byrnes,	April 12, 1887,	1 yr.,	6 %	$4,000 00
W. S. Baker,	May 9, 1888,	3 yrs.,	7 %	1,500 00
Caroline Blymyer et al,	Nov. 23, 1887,	2 yrs.,	6½ %	8,000 00

From.	Date.	Time.	Interest.	Par Value
Mary S. Orange,	Dec. 22, 1880,	3 yrs.,	6 %	2,000 00
John A. Bigelow,	Aug. 31, 1889,	2 yrs.,	6 %	1,000 00
Joseph M. Story,	Nov. 30, 1889,	3 yrs.,	6 %	1,000 00
Margaret A. Shields,	Dec. 3, 1889,	3 yrs.,	6 %	4,000 00
Henry Snow,	Dec. 12, 1891,	3 yrs.,	6 %	2,000 00
Alvin Knop,	Jan. 18, 1892,	4 yrs.,	6 %	6,000 00
Hester V. Froome et al,	Mar. 16, 1892,	5 yrs.,	6 %	3,000 00
Harry Falquet,	June 14, 1892,	3 yrs.,	6 %	2,100 00
Hester V. Froome, additional,	Sept. 16, 1892,	4½ yrs.,	6 %	500 00
John S. Dempsey,	Mar. 1, 1893,	2 yrs.,	6 %	2,000 00
Total Mortgages,				$37,100 00

BONDS AND NOTES.

Cincinnati Southern 7-30 bonds,	$2,000 00
One Cincinnati deficiency bond (1901), 4 %,	500 00
One Cincinnati deficiency bond (1905), 4 %,	100 00
One Procter & Gamble gold bond at 108½, ($1,095.85)	1,000 00
Eight shares ($50 each) Cincinnati St. R. R., at 106¾ ($427.00)	400 00
Total bonds,	$4,000 00

RECAPITULATION.

Real estate mortgages,	$37,100 00
Bonds and notes,	4,000 00
Total,	$41,100 00

Since the last annual report of the Trustees, the loans to Anthony Costello and Richard Oliver have been paid, and also the loan to Aaron A. Ferris. The amounts received from these loans have all been re-invested in mortgages, or bonds, shown by the foregoing report. It will be observed that the par value only is given of the securities held by the Trustees. All of the bonds held by the Trustees represent a premium, and are readily salable in the market for at least the premium paid. The funds have all been invested, and the Trustees, in order to make a purchase in a round sum of the last securities purchased, obtained from the Treasurer of the Society an advance in the sum of twenty-two dollars and eighty-five cents ($22.85). This last named sum was used in the purchase of the eight (8) shares of the Street Railway stock. The Trustees thought best to invest in the bonds and stock, for the reason that it is now very difficult to obtain satisfactory

loans on real estate. The loans that have been made since our last report, on real estate mortgages, have all been made payable in gold, as far as the principal is concerned.

The Trustees suggest that a committee be appointed to examine the securities held by the Trustees.

Respectfully submitted,

AARON A. FERRIS,
P. M. BIGNEY,
Trustees.

REPORT OF CURATOR OF PHOTOGRAPHIC SECTION.

CINCINNATI, April 4, 1893.

THE CINCINNATI SOCIETY OF NATURAL HISTORY:

Gentlemen — As Curator of the Photographic Section of this Society, I beg to submit the following report for the year just ended: This Section now numbers 102 active members, having added to its membership during the past year seven, having lost by death two, by resignation seven, and by dropping from membership on account of the non-payment of dues nine.

On May 30, 1892, our Annual Outing took place, and was attended by over one hundred members. The Section and its friends spent the day at the town of Batavia, and the occasion was one of the most enjoyable yet participated in.

On March 17, 1893, our Annual Exhibition was given at the Scottish Rite Cathedral, but owing to the exceedingly inclement weather, was not as fully attended as it otherwise would have been, yet the exhibition was witnessed by four hundred and twenty-seven members and their friends. The standard of excellence heretofore shown in the work of the Section was fully maintained, and in some respects improved upon, and the interest shown by the members has not in the least diminished. And, although we have lost in membership, from causes already stated, the Section is in a very flourishing condition.

The suggestions submitted by the Curator at the last annual meeting have been acquiesced in by the Executive Board of

the Society, and our members beg to return thanks to the Board of Officers for the noticeable improvement in the condition of the Section.

Very respectfully,

T. B. COLLIER,

Curator Photographic Section.

REPORT OF DIRECTOR OF MUSEUM.

CINCINNATI, April 4, 1893.

OFFICERS AND MEMBERS OF THE CINCINNATI SOCIETY OF NATURAL HISTORY:

Ladies and Gentlemen — Not quite a year has elapsed since your honorable Society saw fit to call the undersigned to it, as its Director of the Museum; almost ten months, to a day, have gone by since the actual relationship began.

What has been accomplished during this interval of time? What are the plans for the ensuing year? Such are your mental questions. In conjunction with the officers of the Society, we shall try to satisfactorily answer them.

Before doing so, however, permit us to state that whatever has been done, was suggested and followed out for the best interests of the Society as we were able to see them. If mistakes have been made, they were due to error of judgment, and as such, we trust you will bear with them, and in the coming months assist us to overcome and correct them.

The cleaning and re-arranging of the several rooms were the main objects of the Summer months. How successfully it has been accomplished, you have been able to judge during your visits to the Museum.

Our aim has been to unite all the various collections of each class, and as rapidly as possible types will be selected to constitute our displays.

In detail, we would call your attention to the changes in the several departments, to-wit:

The mammals have been removed from the second floor to the new large room over the lecture hall. All, save the very larger specimens (which are to be found in the fourth story

front room), have been arranged in the long case against the north wall.

The west wall cases contain the fish exhibit, while the entire floor space is occupied by the palæontological collections in flat show cases.

The front room of the fourth story contains the large plaster casts (surrounded and protected by an iron railing), along with the larger mammals and birds, remains of prehistoric animals and the osteological collection.

The room formerly occupied by the ichthyological collection is now devoted to the department of botany, while the room jointly shared by the botanical specimens and insects is now exclusively entomological.

The departments of ethnology and mineralogy occupy the large room on the third floor, while the specimens pertaining to ornithology, oology and invertebrate zoology, are to be found in the large room on the second floor, which was formerly occupied by the mammals and birds.

After removing the mammals to the upper story, the large and unsightly cases, which formerly contained them, were displaced by flat show cases.

A large sky-light was put in the roof over the large room on the fourth floor, thus converting this dark and almost useless room into one of the brightest and best in the building.

The crowded condition of our rooms, even after these changes, will soon necessitate the use of numerous drawer-cases, for filing the bulk of our collections, so as to be of easy access to actual students.

As it is, our displays are so crowded as to injure their availability and proper labeling, while our basement contains numerous specimens that ought to be made available to students.

The relabeling of specimens and preparation of corrected catalogues will be continued as time permits, as has been done with the mammals.

New methods have been introduced into the office, by which complete and accurate records will be kept of all transactions therein. The lack of such records has already cost the officers many hours of labor, not to mention the intrinsic loss to the Society itself.

The correction of our periodical exchange list, the completion of broken sets and re-checking of bound and unbound publications, not already catalogued, has consumed a goodly portion of the Winter months.

The annual free lecture course for this year (1893) consisted of seven lectures by eminent scientific men. These were well attended, the six already given averaging an attendance of about 150 persons.

Twenty-six hundred and eighty persons have visited the Museum since September 1, 1892 (the day the doors were opened after the Summer's cleaning), an average of 383 per month, thirteen per day. The largest month was March, 1893, with 494 visitors, while Columbus day, October 21, 1892, was the largest day, with 121 visitors.

So, if interest in the Museum and appreciation of its advantages can be taken as an index, we are certainly in a healthy condition.

One of the past features of the Society, its educational work — we refer to the Lyceum of Natural History — ought to be revived at the earliest possible moment, as it would be of great and permanent advantage to the Society in adding younger members to its lists. We speak thus positively, because of the great interest shown in the work by many of our high school pupils, who would take advantage of a practical course in natural history.

Last Sunday (April 2, 1893,) for the first time in the history of the Society, were its doors thrown open on Sunday afternoons. Thirty-six (36) persons took advantage of this opportunity to visit the Museum and study our collection.

How beneficial it will prove to the Society remains to be seen. But, judging from other museums, we will be the gainers, and further, we owe it to those among us who can not visit us on week days.

In the future, as in the past, everything that can be done for the Society and science will be done. But we need the help of each one of you. Attend the meetings regularly, visit the Museum, and bring in new active members.

Respectfully submitted,

SETH HAYES,

Director of the Museum.

THE MYXOMYCETES OF THE MIAMI VALLEY, OHIO.

By A. P. Morgan.

Second Paper.

(Read May 2, 1893.)

Order III. PERICHÆNACEÆ.

Sporangia sessile or plasmodiocarp; the wall a thin membrane, with a more or less thickened outer layer of minute brownish scales and granules. Capillitium of long and very slender tubules, proceeding from numerous points of the sporangial wall, loosely branched, forming no evident network, the surface minutely warted or spinulose. Spores globose, oval, or somewhat irregular, yellow.

The order is distinguished by the sessile sporangia, with thick brown walls, and the very slender threads of the capillitium, with irregular and indefinite markings.

Table of Genera of Perichænaceæ.

1. Perichæna. Sporangia more or less depressed, roundish or more commonly polygonal and irregular, dehiscent in a circumscissile manner.
2. Ophiotheca. Plasmodiocarp terete and more or less elongated, bent and flexuous, sometimes annular or reticulate, irregularly dehiscent.

I. PERICHÆNA, Fr. Sporangia more or less depressed, roundish or more commonly polygonal and irregular, the edges approximate and sometimes confluent; the wall a thin

membrane, with a thick dense yellow-brown outer layer of minute scales and granules, becoming darker at the surface, dehiscent in a circumscissile manner. Capillitium of very slender loosely-branched threads, with the surface minutely warted. Spores globose, oval or somewhat irregular, yellow.

Distinguished from Ophiotheca by the flattened sporangium with a regular circumscissile dehiscence.

1. Perichæna depressa, Lib. Sporangia very much depressed, polygonal, irregular, crowded, the edges contiguous, sometimes confluent; the wall thick, yellow-brown within and scarcely impressed by the spores; the outer surface smooth, brown-red to brown or blackish in color, dehiscent in a circumscissile manner. Capillitium of slender loosely-branched threads, 1–3 mic. in thickness, the surface merely uneven or very minutely warted. Spores globose, yellow, 9–10 mic. in diameter. See Plate I, Fig. 13.

Growing on the inside of the bark of Juglans, Acer, etc. Sporangia variable in size, 7–1.3 mm. in breadth, irregular and angular, much flattened. It is said to include *Perichæna vaporaria*, Schw.

2. Perichæna irregularis, B. & C. Sporangia depressed, irregular, polygonal, crowded, the edges contiguous and sometimes confluent; the wall thick, yellow inside and faintly reticulately impressed by the spores, the outer surface smooth, purplish-brown, dehiscent in a circumscissile manner. Capillitium of slender-loosely branched threads, about 2 mic. in thickness, the surface minutely warted or spinulose. Spores subglobose, yellow, 9–10 mic. in diameter.

Growing on the outer bark of Acer, etc. Sporangium .5–.6 mm. in width, closely crowded and irregular. It is much smaller than *Perichæna depressa*, and its threads are more distinctly warted and spinulose.

3. Perichæna corticalis, Batsch. Sporangia globose, the base depressed, gregarious; the wall thick, yellow within and distinctly reticulately impressed by the spores, the outer surface reddish-brown or yellow-brown in color, dehiscent in a circumscissile manner. Capillitium of slender loosely-branched threads, about 2 mic. in thickness, the surface very minutely warted. Spores subglobose, yellow, 10–12 mic. in diameter.

Growing on the inside of the bark of Elm. Sporangia .5–.6 mm. in diameter, quite regular in shape, with a slightly flattened base. My specimens are from Prof. McBride, of Iowa.

4. PERICHÆNA MARGINATA, Schw. Sporangia depressed, polygonal, approximate and sometimes confluent, the surface cinereous-pulverulent, seated on a silvery hypothallus; the wall firm, thick, the outer surface yellow-brown, covered with minute whitish scales, the inner surface yellow, deeply reticulately impressed by the spores which rest against it, dehiscent in a circumscissile manner. Capillitium consisting of a few simple or somewhat branched threads or well-nigh obsolete. Spores subglobose, yellow, 12–14 mic. in diameter.

Growing on the outer surface of the bark of Acer, Fagus, etc. Sporangia .4–.6 mm. in width. This is plainly *Perichæna cano-flavescens*, Raunkier. I do not find any threads of a capillitium in my specimens.

II. OPHIOTHECA, Currey. Plasmodiocarp terete and more or less elongated, bent and flexuous, sometimes annular or reticulate, the surface not polished or shining: the wall a thin membrane, with a thin outer layer of minute scales and granules, irregularly dehiscent. Capillitium of very slender loosely-branched threads, with the surface minutely warted and spinulose. Spores globose, oval or somewhat irregular, yellow.

Distinguished from Perichæna by the terete plasmodiocarp and by the more spinulose capillitium. *Cornuvia* of Rostafinski.

1. OPHIOTHECA CHRYSOSPERMA, Currey. Plasmodiocarp globose or oblong to elongated, and bent or flexuous, sometimes annular or branched and reticulate, dull brown in color; the wall a thin yellowish membrane, with a thin yellow-brown outer layer, irregularly dehiscent. Capillitium of slender loosely-branched threads, 2–3 mic. in thickness, the surface minutely spinulose. Spores subglobose, yellow, 8–9 mic. in diameter.

Growing on the inner surface of old bark of Quercus, etc. Plasmodiocarp .4–.5 mm. in thickness, variable in length. *Cornuvia circumscissa* of Rostafinski's monograph.

2. OPHIOTHECA WRIGHTII, B. & C. Plasmodiocarp more or less elongated, bent and flexuous, very commonly in small rings, from brownish-ochre to brown or blackish in color, not polished; the wall a thin yellow membrane, with a thin brown outer layer, irregularly dehiscent. Capillitium of slender loosely-branched threads, 2–3 mic. in thickness, furnished with numerous straight or bent long-pointed spinules. Spores subglobose, yellow, minutely warted, 10–12 mic. in diameter. See Plate I, Fig. 14.

Growing on the inside of bark of Acer, Carya, etc. Plasmodiocarp about .5 mm. in thickness, variable in length, often in small rings 1–2 mm. in diameter. The prickly threads are quite characteristic; the spinules are 3–5 mic. in length. *Hemiarcyria melanopeziza*, Speg., is evidently the same thing.

3. OPHIOTHECA VERMICULARIS, Schw. Plasmodiocarp terete and more or less elongated, bent and flexuous, sometimes annular or reticulate, the surface not polished, brownish in color; the wall a thin yellow membrane, covered on the outside by a more or less thickened brown layer of scales and granules, irregularly dehiscent. Capillitium of slender loosely branched threads, 2–3 mic. in thickness, the surface with minute warts and ridges. Spores subglobose, yellow, 10–12 mic. in diameter.

Growing on the inside of old bark. Plasmodiocarp about .4 mm. in thickness and various in length; in my specimens the sporangia are mostly small rings. The species looks exactly like *Ophiotheca Wrightii*, but the character of the threads is quite different.

4. OPHIOTHECA PALLIDA, B. & C. Plasmodiocarp terete, oblong or elongated annular and flexuous, the surface dull, pale ochraceous; the wall a thin pellucid membrane, minutely granulate, with a thin pale ochraceous outer layer, irregularly dehiscent. Capillitium of slender loosely-branched threads, 2–3 mic. in thickness, the surface minutely warted or spinulose. Spores subglobose, pale yellow, 10–12 mic. in diameter.

Growing on dead stems of herbaceous plants. Plasmodiocarp .3–.4 mm. in thickness, variable in length, sometimes short and roundish or oblong, sometimes much elongated and flexuous. More delicate than *Ophiotheca vermicularis*, and distinguished by its pallid color throughout.

ORDER IV. ARCYRIACEÆ.

Sporangia regular and stipitate, rarely sessile; the wall a thin membrane, minutely granulose, colored as the spores and capillitium, the upper part soon torn away in a somewhat circumscissile manner, and early disappearing. Capillitium of slender tubules, repeatedly branching and anastomosing to form a complicated network of evident meshes, more or less expanded after dehiscence; the surface of the threads minutely warted or spinulose or with elevated ridges in the shape of rings, half rings or reticulations.

This order is specially distinguished by the threads of the capillitium forming a complicated network of evident meshes.

TABLE OF GENERA OF ARCYRIACEÆ.

1. LACHNOBOLUS. Capillitium of slender tubules, quite variable in thickness, proceeding from numerous points of the sporangial wall.
2. ARCYRIA. Capillitium of slender tubules, issuing from the interior of the stipe, the network without any free extremities.
3. HETEROTRICHIA. Capillitium issuing from the interior of the stipe, the peripheral portion of the network bearing numerous short acute free branches.

I. LACHNOBOLUS, Fr. Sporangia stipitate or sessile, the wall a thin delicate membrane, minutely granulose, rupturing irregularly. Stipe short or sometimes wanting. Capillitium of slender tubules quite variable in thickness, proceeding from numerous points of the sporangial wall and forming a complicated network, the surface minutely warted or spinulose. Spores globose, yellowish or flesh-color.

This genus differs from Arcyria in the capillitium springing from numerous points of the sporangial wall.

1. LACHNOBOLUS GLOBOSUS, Schw. Sporangia globose, stipitate, pale yellow, changing to clay-color; the wall thin and delicate, pellucid, minutely granulose, the upper part torn away and soon disappearing, the lower half more persistent. Stipe short, tapering upward, expanding at the base into a small hypothallus. Capillitium arising from the lower portion of the sporangium, forming a complicated network, the threads 3–5 mic. in thickness, the surface closely covered with minute warts. Spores globose, pale yellow to clay-color in mass, 8–9 mic. in diameter. See Plate I, Fig. 15.

Growing on the spines of Chestnut burs. Sporangia .5–.6 mm. in diameter, the stipe shorter than the sporangium.

2. LACHNOBOLUS INCARNATUS, A. & S. Sporangia globose or ellipsoidal, substipitate, closely crowded and seated on a common hypothallus; the wall thin and delicate, pellucid, minutely granulose, dehiscing irregularly. Stipe very short or often obsolete. Capillitium proceeding from the inner surface of the sporangial wall, forming a complicated network, the threads extremely variable in thickness, minutely warted and spinulose. Spores globose, flesh-color in the mass, 8–9 mic. in diameter.

Growing on old wood. Sporangia .5–.8 mm. in height, sessile on a narrow base or with a very short stipe; the threads of the capillitium are generally 3–5 mic. in thickness, but there are broader expansions at the nodes and elsewhere. My specimens are from Prof. McBride, of Iowa. The species is extremely variable, and these specimens differ much from those described elsewhere.

II. ARCYRIA, Hill. Sporangia regular ovoid to cylindric, stiptiate; the wall a thin delicate membrane, circumscissile or torn away near the base, the upper portion evanescent, the lower part persistent, small and cup-shaped. Stipe more of less elongated, the interior containing roundish vesicles which become smaller upward, and gradually pass into the normal spores. Capillitium of slender tubules, issuing from the interior of the stipe, forming a complicated network, without

any free extremities, the surface minutely warted or spinulose or with annular ridges. Spores globose, red, brown, yellow, cinereous.

§1. CLATHROIDES, Mich. Capillitium closely attached by a few threads which issue from the interior of the stipe, and are free from the calyculus (except in *A. punicea*), much elongated after dehiscence, weak and drooping or prostrate; the meshes open and irregular, not differing externally and internally, their threads similar throughout, the warts or ridges of the surface exhibiting a spiral arrangement.

1. ARCYRIA PUNICEA, Pers. Sporangium ovoid, more or less elongated; the calyculus small, plicate-sulcate. Stipe long, erect, brownish-red in color, expanded at the base into a small hypothallus, Capillitium firmly attached by numerous threads which are connate with the wall of the calyculus, much elongated after dehiscence, ovoid-oblong to cylindric, bright red in color, fading to red-brown or brownish-ochre; the threads uniform in thickness, about 3 mic., the surface with a series of prominent half-rings, which wind around the thread in a long spiral. Spores globose, even, 6–8 mic. in diameter.

Growing on old bark, wood, mosses, etc. The stipe 1–2 mm. in length, the capillitium elongated 2–4 mm. The commonest of the species, conspicuous by reason of its bright red color.

2. ARCYRIA MINOR, Schw. Sporangium ovoid-oblong; the calyculus small, sulcate and ribbed, granulose. Stipe short, erect, brownish-red in color, standing on a thin hypothallus. Capillitium much elongated after dehiscence, oblong to cylindric, lax and prostrate, bright red to brownish in color; the threads uniform in thickness, 2.5–3 mic., the surface with a series of prominent half-rings, which wind around the thread in a long spiral. Spores globose, even, 7–9 mic. in diameter. See Plate I, Fig. 17.

Growing on old wood, bark, Polyporus, etc. The stipe .4–.7 mm. in length, the capillitium elongated 1.5–3 mm. Not uncommon, but it is usually referred to *A. adnata*.

3. ARCYRIA ADNATA, Batsch. Sporangium ovoid; the calyculus very small, finely ribbed and granulose. Stipe very

short or entirely wanting. Capillitium much expanded after dehiscence, globose or obovoid, pale red to brownish in color: the threads uniform in thickness, about 4 mic., the surface with a series of prominent half-rings with mingled warts and spines, which wind around the thread in a long spiral. Spores globose, even, 6–8 mic. in diameter.

Growing in small clusters on old wood. A small species, the capillitium expanded 1–2 mm., the stipe extremely short, or altogether absent.

4. ARCYRIA NUTANS, Bull. Sporangium cylindric; the calyculus small, granulose, ribbed and sulcate. Stipe very short, arising from a common hypothallus. Capillitium greatly elongated after dehiscence, cylindric, drooping and pendulous, pale yellow or pale ochraceous; the threads 3–4 mic. in thickness, the surface covered with spinules, among which are rings and half-rings, with an indistinct spiral arrangement. Spores globose, even, 7–9 mic. in diameter.

Growing on old wood. The capillitium elongated 4–8 mm., the stipe very short. A very conspicuous species by reason of its long pale yellow capillitium.

§2. PLECTANELLA. Capillitium erect, firmly attached by numerous threads, which issue from the interior of the stipe, but are connate with the wall of the calyculus, after dehiscence not much expanded: the meshes at the surface of the network much smaller than those within, folded back and forth, narrow and irregular, their threads densely warted or spinulose; the meshes of the interior much larger open and expanded, their threads with minute scattered warts or perfectly smooth.

5. ARCYRIA CINEREA, Bull. Sporangium ovoid or oblong-ovoid; the calyculus very small. Stipe long, erect, cinereous, becoming blackish, standing on a thin hypothallus. Capillitium not much expanded after dehiscence, ovoid-oblong, erect, pale cinereous, sometimes pale yellowish; the external threads densely spinulose, 2–3 mic. in thickness; the threads of the interior thicker, 3–5 mic., and very minutely warted or quite smooth. Spores globose, even, 6–8 mic. in diameter.

Growing on old wood. Capillitium 1–2 mm. long, the stipe about the same length.

6. Arcyria Cookei, Mass. Sporangium ovoid-cylindric, the calyculus very small. Stipe long, erect, gray to mouse-color, darker below, arising from a thin hypothallus. Capillitium not much expanded after dehiscence, ovoid-cylindric, erect, gray to mouse-color; the superficial threads densely and uniformly covered with minute warts, 3–5 mic. in thickness; the threads of the interior thinner, about 2 mic. and smooth, or with very minute scattered warts. Spores globose, even, 6–8 mic. in diameter. See Plate I, Fig. 16.

Growing on old wood, mosses, etc. Capillitium 1–2 mm. long, the stipe about the same length. It seems as common as *Arcyria cinerea*, and has heretofore been included in it. See Massee's Monograph, p. 154.

7. Arcyria digitata, Schw. Sporangium cylindric, the calyculus very small. Stipe long, ascending, brownish in color, usually several fasiculate or to some extent connate, the sporangia divergent at the apex. Capillitium not much expanded after dehiscence, cylindric, pale cinereous, or pale yellowish; the threads variable in thickness. 2–4 mic., those at the surface densely and minutely warted, those of the interior nearly smooth. Spores globose, even, 6–8 mic. in diameter.

Growing on old wood. Capillitium 2–4 mm. long, the stipe about the same length. *Arcyria bicolor*, B. & C.

III. HETEROTRICHIA, Massee. Sporangia regular, oblong-ovoid, stipitate; the wall a thin delicate membrane, the upper part disappearing at maturity, leaving the basal portion as a small calyculus. Stipe filled with large thick-walled vesicles, which are sub-angular from mutual pressure; these become smaller upward, and pass gradually into normal spores. Capillitium issuing from the interior of the stipe, the central and superficial threads dissimilar, forming a complicated network, with numerous free extremities, the surface minutely warted, or with annular ridges. Spores globose, brownish.

Distinguished from Arcyria by the numerous free extremities of the peripheral portion of the network.

1. HETEROTRICHIA GABRIELLÆ, Massee. Sporangium oblong-ovoid, stipitate; the calyculus small, thin, smooth. Stipe very short, erect, yellowish-brown in color. Capillitium much elongated after dehiscence, cylindric-ovoid, sub-erect; the threads of the central portion about 1.5 mic. thick, with slightly elevated ridges partly encircling the tube, nearly colorless; threads of the peripheral portion bright yellow, 5–6 mic. thick, with numerous short acute free branches, the surface densely and minutely warted. Spores in mass, yellowish-brown, globose, even, 7–8 mic in diameter. See Plate I, Fig. 18.

Growing on wood; S. Carolina, *H. W. Ravenel.* The sporangia densely crowded, becoming scattered toward the margin of the cluster. Massee's Monograph of the Myxogasters.

ORDER V. TRICHIACEÆ.

Sporangium regular and stipitate or sessile, rarely plasmodiocarp; the wall a thin membrane, usually granular or venulose on the inner surface, colored as the spores and capillitium, irregularly dehiscent. Capillitium of slender tubules, simple or branched, scarcely forming an evident network; the surface of the threads furnished with continuous ridges, which wind around the tube in a spiral manner. Spores globose, red, brown, yellow, olivaceous.

This order is readily recognized by the spiral ridges which wind around the tubules of the capillitium.

TABLE OF GENERA OF TRICHIACEÆ.

1. HEMIARCYRIA. Capillitium of long slender tubules, arising from the base of the sporangium, or issuing from the interior of the stipe; the spiral ridges parallel and conpicuous.

2. CALONEMA. Capillitium of slender tubules, arising from the base of the sporangium; the surface traversed by a system of branching veins.

3. TRICHIA. Capillitium consisting of numerous short slender tubules, called elaters, which are wholly free; the spiral ridges parallel and conspicuous.

4. OLIGONEMA. Capillitium scanty, composed of elaters habitually irregular and abnormal; the surface variously marked.

I. HEMIARCYRIA, Fr. Sporangia regular and stipitate, rarely plasmodiocarp, the wall at maturity breaking away from above downward, leaving more or less of the lower portion persistent. Stipe more or less elongated, rarely wanting, resting on a thin hypothallus. Capillitium of long slender tubules, more or less branched, arising from the base of the sporangium, or issuing from the interior of the stipe; the spiral ridges parallel and conspicuous, 3–5, rarely more in number, smooth or spinulose. Spores globose, red, yellow.

The genus is related on the one hand to Arcyria by the mode of attachment of the threads, on the other hand to Trichia, by the parallel spiral ridges which wind around them. By the mode of branching of the threads, the species fall readily into two sections.

§1. ARCYRIOIDES. Capillitium of slender threads, branching and anastomosing, thus forming a more or less evident network.

In some of the species the large irregular meshes of the network are scarcely to be discerned, but are rather to be inferred from the abundant branching of the threads and the paucity of the free extremities.

1. HEMIARCYRIA PLUMOSA, Morgan, n. sp. Sporangium obovoid to turbinate, olive-yellow to olive-brown in color, stipitate; the wall densely granulose within, externally smooth and shining, the upper part soon disappearing, leaving a funnel-shaped persistent base. Stipe long, erect, reddish-brown, arising from a thin hypothallus. Capillitium of threads 5–7 mic. in thickness, repeatedly branched and anastomosing, to form a dense network without any free extremities,

olive-yellow to olive-brown in color; the spiral ridges five or six, close, smooth. Spores in mass, lemon-yellow, globose, very minutely warted, 8–9 mic. in diameter. See Plate I, Fig. 19.

Growing gregariously on old damp logs; very common in this region. Sporangium with the stipe 2–3 mm. in height, the stipe usually much longer than the sporangium; the capillitium expands considerably after the disappearance of the upper part of the sporangium. This species is an Arcyria in every respect, except the spiral ridges, which wind about the thread of the capillitium.

2. Hemiarcyria Varneyi, Rex. Sporangium elongated ovoid, pale yellow, stipitate; the upper part of the wall disappearing at maturity, leaving a small cup-shaped persistent base. Stipe very short, dull brown. Capillitium of very slender threads 3.2–3.5 mic. in thickness, dull ochre in color, forming a network of small meshes, with numerous short slightly clavate free extremities, which proceed from the peripheral meshes; the spiral ridges seven or eight, winding unevenly, those of the superficial threads minutely spinulose. Spores in mass pale yellow, globose, even, 6–7 mic. in diameter.

Growing on old wood; Kansas, May Varney. Sporangium with the stipe about 1 mm. in height, the stipe very short. Dr. Rex, in Proceedings of the Academy of Natural Sciences, Philadelphia, 1891.

3. Hemiarcyria ablata, Morgan n. sp. Sporangium obovoid to turbinate, yellow or olive-yellow, stipitate; the wall rather firm, smooth and shining, breaking away about the apex, leaving the greater portion persistent. Stipe short, erect, yellow-brown to blackish in color, arising from a thin hypothallus. Capillitium of threads, 5–7 mic. in thickness, yellowish-ochre in color, more or less branched; the free extremities very scarce, obtuse or slightly swollen; the spiral ridges four or five, close, smooth or very minutely warted. Spores in mass, yellow, globose, minutely warted, 8–9 mic. in diameter.

Growing on old wood of Elm, etc. Sporangium with the stipe 1.5–2.5 mm. in height, the stipe variable in length, but not longer than the sporangium, diameter of the sporangium

.6–.8 mm. A half dozen threads proceed from the inner wall of the stipe branch twenty-five or thirty times, and afford scarcely half a dozen free ends.

4. HEMIARCYRIA STIPATA, Schw. Sporangia terete, elongated and flexuous, closely packed together and lying upon one another, stipitate, from bright incarnate to brick red or bay in color, smooth and shining; the wall thin and fragile, soon disappearing, except a small cup-shaped portion at the base. The stipes very short, often entirely concealed by the dense mass of sporangia, arising from a common hypothallus. Capillitium of threads somewhat variable in thickness, 3–6 mic., repeatedly branched and forming a network of very unequal meshes, with occasional clavate free extremities, pale to dark red in color; the spiral ridges three or four, often irregular, thickened or interrupted by minute warts and spinules. Spores in mass incarnate to brownish-red, globose, even, 7–9 mic. in diameter.

Growing on old wood of Liriodendron. Sporangia usually in small patches, each 1–2 mic. in length, the stipe very thin and short.

§2. HEMITRICHIA. Capillitium of very long slender threads, simple or remotely branched, and not forming a network, their further extremities all free.

The threads of the capillitium in these species are usually much coiled and entangled, but when straightened out they are seen to be very long, but few in number, fixed at one end and free at the other.

5. HEMIARCYRIA LONGIFILA, Rex. Sporangium obovoid or pyriform, yellow, stipitate; the wall a thin pellucid membrane, smooth and shining, beautifully iridescent, breaking away above the middle, the lower cup-shaped portion persistent. Stipe very short, reddish-brown to blackish, arising from a common hypothallus. Capillitium of slender threads, 3.5–4 mic. in thickness, golden yellow in color, simple or very rarely branched; the free extremities obtuse or slightly swollen, sometimes minutely apiculate; the spiral ridges, three or four, rather distant, with very minute scattered spinules or nearly smooth. Spores in mass, golden-yellow, globose, minutely warted, 9–10 mic. in diameter.

Growing on old wood of Oak, etc. Sporangium with the stipe .8–1.5 mm. in height, the stipe very short, not exceeding the diameter of the sporangium. A small species, distinguished by its golden-yellow spores and capillitium.

6. HEMIARCYRIA FUNALIS, Morgan n. sp. Sporangium obovoid to turbinate, yellow or olive yellow, polished stipitate; the wall firm, thickened on the inner surface by an olivaceous layer, breaking away from above downward, leaving an irregular cup-shaped base. Stipe short, reddish-brown to blackish, arising from a thin hypothallus. Capillitium of threads 6–8 mic. in thickness, yellowish-ochre or dull ochre in color, simple or remotely branched; the free extremities obtuse or swollen; the spiral ridges four or five, minutely warted. Spores in mass yellow, globose, minutely warted, 8–9 mic. in diameter. See Plate I, Fig. 20.

Growing on old wood. Sporangium 1.5–2.5 mm. in height, the stipe variable, but usually much shorter than the sporangium. Scarcely to be distinguished from *Hemiarcyria ablata*, except by the threads of the capillitium.

7. HEMIARCYRIA RUBIFORMIS, Pers. Sporangium obovoid or turbinate to cylindric, usually few to many fasciculate upon the united stipes, sometimes sessile, brown-red to brown or blackish in color, smooth and often shining with a metallic luster; the wall much thickened by a dense brownish-red layer of minute granules, at maturity the apex torn away, leaving much the greater part persistent. Capillitium of slender threads, 4-6 mic. in thickness, brownish-red in color, very rarely branched; the free extremities usually terminated by a stout spine; the spiral ridges three or four, furnished with numerous spinules. Spores in mass, brownish-red, globose, minutely warted, 9–11 mic. in diameter.

Growing on old wood; one of the commonest of the Myxomycetes. The fascicle 3–4 mm. in height, the individual sporangia .5–.6 mm. in diameter.

8. HEMIARCYRIA SERPULA, Scop. Plasmodiocarp terete, flexuous, usually branching and anastomosing to form an extensive network, from tawny to golden-yellow in color; the wall thin above and yellow, breaking open irregularly and falling away down to the brownish thicker adherent base.

Capillitium consisting of a few long slender threads with numerous scattered short branches, the threads 4–6 mic. in thickness, golden-yellow; the free ends of the branches terminating in a slender spine; the spiral ridges three or four, covered with numerous slender spinules. Spores in the mass golden-yellow, globose, the surface reticulate, 10–12 mic. in diameter.

Growing on and inside of rotten wood. Plasmodiocarp an irregular patch, one to several centimeters in extent, the strands of the net about .5 mm. in thickness. A single reticulate plasmodium is usually converted without change of form into an individual plasmodiocarp.

II. CALONEMA, Morgan, gen. nov. Sporangia subglobose, irregular, sessile, without a hypothallus; the wall thin, marked with branching veins, irregularly dehiscent. Capillitium of slender tubules, arising from the base of the sporangium, repeatedly branched and with numerous free extremities; the surface traversed by a system of branching veins, ending in minute veinlets, which appear as irregular rings and spirals. Spores subglobose, yellow.

The habit of the single species is that of an Oligonema, and it has spores similar to those of most species of this genus, but the threads are long and branched, and they are fastened below to the base of the sporangium.

1. CALONEMA AUREUM, Morgan n. sp. Sporangia subglobose to turbinate, sessile, closely crowded and from mutual pressure quite irregular; the wall thin, marked with branching veins, golden-yellow in color, smooth and shining. Capillitium of threads more or less branched, 5–6 mic. in thickness, golden-yellow; the surface minutely venulose, and with larger rings and spirals, and sometimes with scattered spinules; the free extremities obtuse. Spores subglobose, yellow, the surface with elevated ridges combined into a network, 14–16 mic. in diameter. See Plate I, Fig. 21.

Growing on and within rotten wood. Sporangia quite irregular and variable in size, .3–.6 mm. in diameter. The beautiful venation of the wall of the sporangium is continued upon the surface of the threads of the capillitium.

III. TRICHIA, Haller. Sporangia regular and stipitate or sessile and somewhat irregular; the wall, at maturity, irregularly ruptured. The stipe more or less elongated or often wanting, usually resting on a hypothallus. Capillitium consisting of numerous short slender tubules, called *elaters*, intermingled with the spores and wholly free; elaters simple or rarely branched a time or two, each extremity terminating in a smooth tapering point; the spiral ridges parallel and conspicuous, 2–5 in number, smooth or spinulose. Spores globose, yellow, ochraceous, olivaceous.

The genus Trichia is unique among the Myxomycetes in having its capillitium composed of tubules, which are entirely free from the wall of the sporangium. The length of these free tubes varies usually between .3 mm. and .5 mm., being sometimes shorter, but seldom longer; they are typically cylindric, or equally thickened from end to end, or quite rarely they are thickened in the middle, and taper gradually to each extremity; the extremities terminate in a smooth tapering point, straight or sometimes a little curved or flexuous, which maintains an average length in each species. The spiral ridges wind around the thread almost invariably to the left, or with the hands of a watch; they are always more or less prominent and conspicuous, and usually maintain a regular curve and uniform interval between each other in the same species; their surface is either smooth, or sometimes it is invested with minute warts or spinules.

In all the species of this genus, however, irregular and abnormal elaters are occasionally met with among the typical ones. As these abnormal forms always arrest attention, and have been conceived to possess specific value, it may be well to note the principal of them.

1. The elater is sometimes branched. In two or three species the branching appears to be quite regular and not abnormal; still, even in these species, most of the elaters in the sporangia are not branched. In some cases the branching arises from confluence of two or more elaters.

2. Ellipsoidal swellings, or enlargements of the elater, sometimes occur, at one or both extremities, or at points intermediate between them; these always occur irregularly, and are essentially abnormal.

3. The smooth tapering point is rarely wanting, in which case the extremity presents a blunt end, the spiral ridges running to the end. More frequently the tapering points are multiplied, the elaters bearing two or three spines at the extremities; this often occurs in the species of Trichia, and also of Hemiarcyria with spinulose elaters.

4. The spiral ridges are sometimes defective, there being less than the typical number; sometimes they are merely displaced, there being a much wider interval between them than usual; rarely do they habitually wind about the thread in an irregular manner.

5. Under high magnifying power, fine ridges are sometimes seen running lengthwise of the elaters, bridging the intervals between the spirals. These were first observed by DeBary, in *Trichia chrysosperma*, but they have since been seen in the elaters of nearly every other species of Trichia, and also in species of Hemiarcyria.

The few species with elaters, so far as yet known, habitually irregular, defective and abnormal, are referred to the genus Oligonema.

The normal species of Trichia arrange themselves quite naturally into three sections.

§1. ANACTIUM. Sporangia varying from globose to pyriform or turbinate, supported on a more or less elongated stipe. Spores globose, the surface minutely warted.

a. Elaters with very long tapering extremities.

1. TRICHIA FRAGILIS, Sow. Sporangia obovoid to pyriform or clavate, often fasciculate, stipitate; the wall a thin membrane, with a thick dense outer layer of brown-red granules. Stipes long, erect or curved, simple or usually fasciculate and often connate, arising from a thin hypothallus. Mass of spores and capillitium from reddish-brown to yellow and ochraceous; elaters simple, rarely branched, 4–5 mic. thick, with very long tapering extremities, ending in smooth points 8–12 mic. long; spirals, three or four, perfectly smooth. Spores globose, minutely warted, 10–12 mic. in diameter.

Growing on old wood. Sporangia with the stipe 2–4 mm. in height, the sporangium .6–.8 mm. in diameter, the stipe usually longer than the sporangium. The color quite variable, mostly dull red-brown or blackish-brown, more rarely yellow or coffee-brown, usually opaque, rarely shining.

2. Trichia fallax, Pers. Sporangium obovoid to pyriform or turbinate, rarely clavate, stipitate; the wall thin, smooth and shining, colored as the spores and capillitium. Stipe more or less elongated, simple, erect, brownish below, filled with roundish vesicles. Mass of capillitium and spores yellowish, ochraceous or olivaceous; elaters simple or sometimes with several branches, 4–6 mic. thick in the middle, tapering gradually to each extremity, ending in smooth tapering points, 20–40 mic. in length; spirals, three, perfectly smooth. Spores globose, minutely warted, 10–12 mic. in diameter. See Plate I, Fig. 22.

Growing on old wood. Sporangium with the stipe 2–4 mm. in height, sporangium .6–.8 mm. in diameter, the stipe usually longer than the sporangium. Under high magnifying power the spores are seen to be minutely reticulated.

b. Elaters cylindric, ending in a smooth tapering point.

3. Trichia subfusca, Rex. Sporangium globose, rarely globose-turbinate, stipitate; the wall thickish, dull tawny-brown above, shading to dark brown at the base. Stipe simple, erect, brown or blackish in color. Mass of capillitium and spores bright yellow; elaters simple, rarely branched, cylindric, 3.5–4 mic. in thickness, ending in smooth tapering points, 10–12 mic. in length; spirals, four in number, perfectly smooth. Spores globose, minutely warted, 11.5–12.5 mic. in diameter.

On old wood and bark, Adirondack Mountains, New York. Dr. George A. Rex. Sporangium .5–.8 mm. in diameter, the stipe equal in height to the diameter of the sporangium.

4. Trichia erecta, Rex. Sporangium globose to globose-turbinate, stipitate; the wall of both sporangium and stipe with a rough outer layer of brown scales and granules, which, on the upper surface of the sporangium, soon breaks up into

irregular patches. Stipes long, erect, usually simple, rarely fasciculate and connate. Mass of capillitium and spores, bright yellow; elaters simple, cylindric, 4 mic. in thickness, ending in smooth points, 4–6 mic. long; spirals four, often united by intervening branches, covered with numerous irregular spinules. Spores globose, minutely warted, 12–14 mic. in diameter.

Growing on old wood and bark, Adirondack Mountains, New York, Dr. Geo. A. Rex. Sporangium .5–.8 mm. in diameter, the stipe about 1 mm. in height. This Trichia is conspicuous by the checkering or areolation of the upper surface in the mature sporangia, affording a sharp contrast between the brown patches and the yellow bands.

§2. Chrysophidia. Sporangia globose, obovoid or somewhat irregular, sessile, rarely with a short stipe, usually closely crowded. Spores globose, the surface minutely warted.

a. Elaters perfectly smooth.

5. Trichia varia, Pers. Sporangia globose, obovoid or somewhat irregular, gregarious and scattered or crowded, yellowish, ochraceous or olivaceous, sessile, or with a very short brown or blackish stipe. Mass of capillitium and spores yellow; elaters long, simple or sometimes branched a time or two, 4–5 mic. in thickness, ending in a smooth tapering point, 8–12 mic. long; spirals only two, smooth, very prominent in places, causing the elater to appear notched. Spores globose, oval or somewhat irregular, minutely warted, 10–14 mic. in diameter.

Growing in patches on old wood; a very common species. Sporangium .6–.8 mm. in diameter, or when irregular sometimes elongated to 1 mm. or more. Extremely variable as to the form of the sporangium, but readily recognized by its elaters.

6. Trichia Andersoni, Rex. Sporangia globose or obovoid, sessile, gregarious, closely crowded, or sometimes scattered, the wall thickened with minute scales, in color brownish-ochre or olivaceous. Mass of capillitium and spores yellow; elaters long, simple, 3–4 mic. in thickness, ending in

a very long flexuous point, 14–18 mic. in length; spirals three or four, winding evenly and closely, perfectly smooth. Spores globose, minutely warted, 10–12 mic. in diameter.

Growing on the inside of bark of Acer. Sporangium .4–.5 mm. in diameter. The capillitium is deep orange and the spores olivaceous, but this difference in shade of color between spores and capillitium occurs in other species. *Trichia advenula*, Mass., is a closely related species, the swellings in the elaters having no specific value.

7. Trichia inconspicua, Rost. Sporangia very small, subglobose, sessile, collected together in clusters, or scattered, without any hypothallus; the wall brown, smooth and shining. Mass of capillitium and spores yellow; elaters long, simple, cylindric, 3–4 mic. in thickness, ending in smooth tapering points, 6–7 mic. in length; spirals three or four, close, not prominent, perfectly smooth. Spores globose, minutely warted, 10–12 mic. in diameter.

Growing on bark of Platanus, etc. New York, *Peck;* Iowa, *McBride*. The sporangia spherical or reniform and very small.

b. Elaters spinulose.

8. Trichia Iowensis, McBride. Sporangia subglobose, sessile, gregarious, scattered, or sometimes close and confluent; the wall thickened with minute scales, reddish brown in color. Mass of capillitium and spores yellow; elaters quite variable, usually very long, but sometimes very short, simple, rarely branched, the thickness unequal, 3–4 mic. in the same elater, with occasional thicker swellings, bearing numerous scattered spines, usually about as long as the thickness of the elater, but sometimes much longer, those at the ends being similar; spirals three or four, fine and close, in places nearly obsolete. Spores globose, or more or less irregular, minutely warted, 9–11 mic. in diameter.

Growing on old bark of Populus; Iowa, McBride. Sporangia .4–.5 mm. in diameter. This is a very curious species of Trichia; it suggests *Ophiotheca Wrightii*, but the elaters are short and simple, and there is no question as to the spirals upon them. I could find no branched elaters in my specimen.

9. TRICHIA SCABRA, Rost. Sporangia globose or somewhat irregular, sessile and closely crowded on a well-developed hypothallus; the wall thin, gold-yellow or orange to yellow-brown in color, smooth and shining. Mass of capillitium and spores orange or golden-yellow; elaters long, simple, 4–5 mic. in thickness, ending in a smooth tapering point, 5–8 mic. in length; spirals three or four, covered with numerous short acute spinules. Spores globose, minutely warted, 9–11 mic. in diameter. See Plate I, Fig. 23.

Growing on old wood in patches, sometimes several centimeters in extent. Sporangia .6–1 mm. in diameter. "The papillæ, which cover the spore, show, when highly magnified, a distinct net-like pattern," *McBride*. The elaters of this species are subject to much irregularity in the way of abnormal swellings, duplicating the spines at the apex, etc.; the spinules are sometimes quite obsolete on some or all of the elaters of a sporangium.

§3. GONIOSPORA, Fr. Sporangia obovoid to oblong, sessile and closely crowded on a well-developed common hypothallus. Spores with thick ridges upon the surface, which are combined into a more or less incomplete network of polygonal meshes.

The ridges of the epispore are 1–2 mic. in height, and do not present to the view more than two or three perfect polygons on a hemisphere of the spores; more often the reticulation is imperfect, the ridges being interrupted and defective. When highly magnified these ridges are seen to be "perforated through their thickness with one, two or three rows, or with clusters of cylindrical openings or pits, or are sculptured into intricate plexuses of minute reticulations with quadrilateral interspaces."

10. TRICHIA AFFINIS, DeB. Sporangia obovoid to oblong, sessile and closely crowded on a common hypothallus; the wall thin, golden-yellow to tawny or brownish-yellow, smooth and shining. Mass of capillitium and spores golden to tawny-yellow; elaters long, simple, 4–5 mic. in thickness, ending in a smooth tapering point, 6–10 mic. in length; spirals four, usually spinulose, rarely smooth. Spores angularly or irregularly globose, 10–12 mic. in diameter.

Growing on old wood and bark in small patches of a few millimeters to a centimeter or more in extent. Sporangia .6–.8 mm. in height by .4–.5 mm. in diameter. *Trichia Jackii*, Rost., is included in this species.

11. TRICHIA CHRYSOSPERMA, Bull. Sporangia oblong-obovoid to cylindric, sessile and closely crowded on a well-developed hypothallus; the wall thin, pale citron to olive-yellow, smooth and shining. Mass of capillitium and spores, golden to ochre-yellow; elaters long, simple, 6–8 mic. in thickness, ending in a smooth tapering point, 3–7 mic. in length; spirals four or five, usually smooth, rarely spinulose. Spores angularly or irregularly globose, 12–14 mic. in diameter.

Growing on old wood, in small patches, one to several centimeters in extent. Sporangia 1–2 mm. in height and .5–.6 mm. in diameter. This is readily distinguished from *Trichia affinis* by the larger and differently colored sporangia.

IV. OLIGONEMA, Rost. Sporangia sub-globose, more or less irregular, sessile and closely crowded, often in heaps, one upon another, the wall thin, smooth and shining; hypothallus none. Capillitium scanty, composed of elaters habitually irregular and abnormal, intermingled with the spores; elaters simple or sometimes branched, commonly very short, but varying greatly in length, even in the same sporangium; the surface marked with faint spirals, with a few annular ridges, minutely punctulate or altogether smooth. Spores globose, yellow.

The species of this genus are to be regarded as degenerate Trichias. Of course, the abnormality is exhibited most markedly by the elaters; nevertheless, the sporangia of some of the species have a peculiar habit of heaping themselves upon each other.

A. Surface of the spores reticulate.

a. Elaters with projecting rings.

1. OLIGONEMA NITENS, Lib. Sporangia sub-globose, irregular, sessile, closely crowded and heaped upon each other, the wall thin, yellow, smooth and shining. Mass of capillitium

and spores yellow; elaters simple or sometimes branched, 3-4 mic. in thickness, with a few distant projecting rings, the surface smooth between, or with very faint spirals, the extremities obtuse, or sometimes with a minute apiculus. Spores angularly or irregularly globose, the surface reticulate, 11-14 mic. in diameter.

Growing in small patches on and within rotten wood. Sporangia .4-.5 mm. in diameter; the elaters variable, some with as many as a dozen projecting rings, some with but a few or nearly smooth. *Trichia nitens*, Libert.

2. OLIGONEMA PUSILLA, Schr. Sporangia subglobose, irregular, sessile, scattered or collected together in heaps; the wall thin, yellow, smooth and shining. Mass of capillitium and spores yellow; elaters simple or sometimes branched, 4 mic. in thickness, sometimes with thicker inflated portions, the surface marked with low faint spirals or perfectly smooth; the extremities rounded and usually terminating in a smooth point, 3-5 mic. in length — this point either curved, bent to one side or turned back, and twisted around the extremity as a ring. Spores angularly or irregularly globose, the surface reticulate, 11-14 mic. in diameter.

Growing in small clusters in rotten wood. Sporangia .3-.5 mm. in diameter; the elaters variable in length, scarcely exceeding 100 mic. and often much shorter. *Trichia pusilla*, Schroeter.

b. Elaters with no projecting rings.

3. OLIGONEMA FLAVIDUM, Peck. Sporangia obovoid to oblong, sessile, closely crowded and irregular from mutual pressure; the wall thin, yellow, shining, punctulate or minutely granulose. Mass of spores and capillitium yellow; elaters simple or sometimes branched, 3-4 mic. in thickness, sometimes with thicker inflated portions; the surface punctulate or minutely warted, occasionally marked with very faint spirals; the extremities usually rounded and obtuse, sometimes acute, and rarely with a minute apiculus. Spores angularly or irregularly globose, the surface reticulate, 11-14 mic. in diameter. See Plate I, Fig. 24.

Growing in dense patches on old wood and mosses. Sporangia .4–.6 mm. in diameter, and reaching 1 mm. in height, the elaters usually rather long, sometimes quite long and branched.

4. OLIGONEMA BREVIFILA, Peck. Sporangia subglobose, irregular, sessile, crowded, forming clusters or effused patches; the wall thin, yellow, densely granulose and venulose. Mass of capillitium and spores ochre-yellow; elaters simple or sometimes branched, often very short and fusiform, when elongated having long tapering extremities, sometimes with irregular swollen portions; the surface minutely granulose and rugulose, here and there a few spinules, occasionally with indistinct spirals. Spores angularly or irregularly globose, the surface reticulate, 11–12 mic. in diameter.

Growing on old wood and mosses. Sporangia .4–.5 mic. in diameter, the elaters varying greatly in length, some not more than 20 or 30 mic. long, others more than 100 mic. in length.

B. Spores minutely warted.

5. OLIGONEMA FULVUM, Morgan n. sp. Sporangia rather large, subglobose, sessile, closely crowded and more or less irregular; the wall tawny yellow, very thin and fragile, smooth, shining and iridescent. Mass of capillitium and spores tawny yellow; elaters simple or sometimes branched, mostly very short, 4 mic. in thickness, sometimes with thicker swollen portions; the surface marked with low smooth spirals, in places faint and obsolete; the extremities rounded and obtuse, usually with a very minute apiculus, 1–3 mic. in length. Spores globose, minutely warted, 10–13 mic. in diameter.

Growing on an old effused Sphæria. Sporangia .6–.8 mm. in diameter, the elaters mostly 40–80 mic. in length, rarely much longer and sometimes shorter; the longer elaters and those that are branched often arise from confluence of the shorter ones.

LICHENS OF OHIO.

By E. E. Bogue, Columbus, Ohio.

Read by title, May 2, 1893.

Also at the meeting of the Ohio Academy of Science, at Columbus, December 29–30, 1892.

The Ohio botanists who have devoted their time and attention to this group of plants are few and far between. While there has not been an Ohio man of supreme authority on the group, the number of minor collectors may be as large as that of any other State.

Mr. John L. Riddell, in 1835, published a list of eight (8) Lichens in the "Western Journal of the Medical and Physical Sciences." Six of the number were from Ohio. They were of the most common species. He worked them out as best he could by the use of Acharius' work on the group.

Leo Lesquereux collected a considerable number, but never, so far as I have been able to learn, published a list. His collection was sent to Switzerland.

W. S. Sullivant, in 1840, published a "Catalogue of the Plants Found in the Vicinity of Columbus," but did not include Lichens.

Thos. G. Lea, in 1849, published a "Catalogue of the Plants of Cincinnati," in which was recorded sixty-eight (68) Lichens. Copies of the publication are very scarce. A complete copy of the list and remarks has been secured for this list. Nothing seems to have been done on the group during the succeeding twenty-three years.

Dr. H. C. Beardslee collected at Painesville in 1872. He sent material to Austin for identification. His "Catalogue of Ohio Plants" was published in 1874, but no mention was made of Lichens.

Miss H. J. Biddlecome, at present of Columbus, Ohio, began collecting them in 1874 at Cedar Swamp, near Urbana, Champaign County, and about Springfield. She continued the work for the next four years.

Mrs. E. Jane Spence collected in the same localities in 1876 and a few years later. Miss Biddlecome and Mrs. Spence sent material to Drs. Beardslee and Tuckerman for identification, and each has now a collection of sixty to seventy-five species. These ladies have kindly permitted the use of their lists in making out this one.

Mr. W. C. Werner, at present of the Ohio State University, began collecting Lichens at Painesville in 1879, and has continued the work more or less since.

The author began collecting them in November, 1891, and has improved every opportunity to continue the work. Since June, 1892, my collecting has been for the Botanical Department of the University.

Professor W. A. Kellerman collected at several places during the past season, so that now there is a good supply of material at the University for use of same, and for opportunity of carrying on the work in the Botanical Laboratory, I hereby express my obligation.

I take pleasure in acknowledging the kindness of Miss Clara E. Cummings for identifying the more foliaceous ones. Thanks are especially due to Dr. John W. Eckfeldt for determining the less conspicuous and more difficult species. I have been favored by Mr. Fredrick LeRoy Sargent with the determination of material, and with suggestions on working it out.

No less than twenty-six State and local floras are known to have been published in the State, but only the two above-mentioned listed any Lichens.

It is not expected that this list of one hundred and sixty-six (166) Lichens includes nearly all that can be found in the State. There are probably at least one hundred yet to be brought to light. It is expected that many additions will be made the coming year. With the exception of those quoted from Riddell and Lea, and in a very few other cases, the names given are supported by specimens, nearly all of which are deposited in the Herbarium of Ohio State University.

Localities are given by counties, rather than by small towns. It should be stated that nearly, if not quite all, the collecting that has been done in Champaign County was in and about a cedar swamp. Nearly all the collecting in Fairfield County was at Sugar Grove, a village situated among the hills, on the banks of Hocking River. Franklin County includes all the collections made about Columbus, and an especially good field at Georgesville, a small village on the Big Darby Creek, at the south-western boundary of the county.

E. E. BOGUE.

LICHENES.—Lichens.

TRIBE I. PARMELIACEI.

RAMALINA, Ach.

1. R. CALICARIS (L.) Fr. Champaign, Biddlecome, Spence; Fairfield, Kellerman.
2. R. CALICARIS (L.) Fr. var. CANALICULATA, Fr. Ashtabula, Bogue.
3. R. CALICARIS (L.) Fr. var. FASTIGATA, Fr. Lea (Cat.) Fairfield, Kellerman, on trunks and branches; Ashtabula, Bogue.
4. R. CALICARIS (L.) Fr. var. FRAXINEA, Fr. Painesville, Werner; Fairfield, Kellerman; Franklin, Bogue.
5. R. POLINARIA (Ach.) Ashtabula, Bogue.

CETRARIA, Ach.

6. C. ALEURITES, Tuck. On bare dead branches of Pinus inops; Fairfield, Bogue.
7. C. AURESCENS, Tuck. On bare dead branches of Pinus inops; Fairfield, Bogue.
8. C. CALICARIS (Ach.) Tuck. Champaign, Biddlecome, Spence, Werner; on bare dead branches of Pinus inops; Fairfield, Bogue.

EVERNIA, Ach.

9. E. FURFURACEÆ (L.) Mann. On Pine bark; Fairfield, Bogue.

USNEA, Ach.

10. U. ANGULATA, Ach. Champaign, Biddlecome, Spence.
11. U. BARBATA (L.) Fr. Morgan, Kellerman.
12. U. BARBATA (L.) Fr. var. FLORIDA, Fr. Widely distributed.
13. U. BARBATA (L.) Fr. var. FLORIDA * * RUBIGINEA, Mx. Fairfield, Bogue.

THELOSCHISTES, Norm.

14. T. CONCOLOR (Dick.) Tuck. Common on neglected Apple trees.
15. T. PARIETINUS (L.) Norm. Lea (Cat.) Painesville, Werner; Marion, Bogue.
16. T. PARIETINUS (L.) Norm. var. POLYCARPUS, Ehrh. Champaign, Biddlecome; Ashtabula, Bogue.

PARMELIA, Ach.

17. P. BORRERI, Ach. var. RUDECTA, Tuck. Lea (Cat.) Champaign, Biddlecome, Spence; on trunks; Ashtabula, Franklin, Bogue.
18. P. CAPERATA (L.) Ach. Common on trees, fences and rocks. In fruit, Ashtabula; Fairfield, Bogue.
19. P. CETRATA, Ach. Champaign, Biddlecome.
20. P. COLPODES (Ach.) Nyl. On trunks throughout the State.
21. P. CRINITA, Ach. On trunks in fruit, Marion; Franklin, Bogue.
22. P. OLIVACEÆ (L.) Ach. Ashtabula, Bogue.
23. P. PERFORATA (Jacq.) Ach. Frequent throughout the State.
24. P. PERLATA (L.) Ach. Franklin, Bogue.
25. P. PERTUSA, Schaer. Champaign, Biddlecome.
26. P. SAXITALIS (L.) Fr. Champaign, Biddlecome.
27. P. TILIACEÆ (Hoffm.) Floerk. On Walnut branches,

Morgan, Kellerman; Champaign, Biddlecome, Spence; Ashtabula, Bogue.

PHYSCIA, D. C.

28. P. ADGLUTINATA (Floerk) Nyl. Champaign, Biddlecome; on trunks and branches of Apple, Basswood, Buckeye and Hickory, Franklin, Marion, Bogue.

29. P. AQUALA (Ach.) Nyl. var. DETONSA, Tuck. At base of trees. Not abundant, but widely distributed.

30. P. ASTROIDEA (Fr.) Nyl. Champaign, Biddlecome.

31. P. COMOSA (Eschw.) Nyl. Champaign, Biddlecome.

32. P. GALACTOPHYLLA, Tuck. Champaign, Spence. Lea (Cat.).

33. P. LEANA, Tuck. On trunks. Lea (Cat.).

34. P. LEUCOMELA (L.) Michx. Champaign, Biddlecome. Lea (Cat.).

35. P. OBSCURA (Ehrh.) Nyl. Common on limestone fences, trunks and branches of many species of trees.

36. P. PULVERULENTA (Schreb.) Nyl. Common on limestone fences and trunks.

37. P. SPECIOSA (Wulf.) Nyl. Champaign, Biddlecome, Spence, Werner.

38. P. SPECIOSA (Wulf.) Nyl. var. HYPOLEUCA (Muhl.) Tuck. Champaign, Biddlecome, Spence.

39. P. STELLARIS (L.) Tuck. Common throughout the State on trunks and branches. Abundant on Osage hedges.

40. P. TRIBACEÆ (Ach.) Nyl. On Hickory bark, Ashtabula, Fairfield, Franklin, Bogue.

PYXINE, Fr.

41. P. SOREDIATA, Fr. Champaign, Biddlecome, Spence; Ashtabula, Bogue.

UMBILICARIA, Hoffm.

42. U. DILLENII, Tuck. Fairfield, Werner, Bogue.

43. U. PUSTULATA (L.) Hoffm. Fairfield, Werner, Bogue.

STICTA, Schreb.

44. S. AMPLISSIMA (Scop.) Mass. On trunks, common.

45. S. AURATA (Sm.) Ach. Trunks, Lea (Cat.).

46. STICTA PULMONARIA (L.) Ach. At base of trees, common.

47. S. QUERCIZANS (Mx.) Ach. On rocks, Fairfield, Werner.

NEPHROMA, Ach.

48. N. HELVETICUM, Ach. Greene, Biddlecome; Champaign, Spence. On trunks, Lea (Cat.).

PELTIGERA, Willd.

49. P. APTHOSA (L.) Hoffm. Champaign, Spence.

50. P. CANINA (L.) Hoffm. Champaign, Biddlecome, Spence. Damp places. John L. Riddell (Synop., 1835). Rotten trunks, Lea (Cat.); Ashtabula, Bogue.

51. P. CANINA (L.) Hoffm. var. SPURIA, Ach. Champaign, Biddlecome, Spence.

52. P. HORIZONTALIS (L.) Hoffm. Greene, Biddlecome; Lea (Cat.); Fairfield, Kellerman; Painesville, Werner.

53. P. POLYDACTYLA (Neck.) Hoffm. Common on earth and rotten wood.

54. P. RUFESCENS (Neck.) Hoffm. Champaign, Biddlecome, Spence; Summit, Bogue.

55. P. SCUTATA (Dicks.) Leight. Champaign, Biddlecome. On the earth, Marion, Bogue.

SOLORINA, Ach.

56. S. DESPREAUXII, Montag. On the earth, Lea (Cat.).

PANNARIA, Delis.

57. P. LEUCOSTICTA. Tuck. On Oak bark, Fairfield, Bogue.

58. P. RUBIGNOSA (Thumb.) Delis. Champaign, Spence.

COLLEMA, Hoffm.

59. C. CRISPUM, Bore. Champaign, Biddlecome.

60. C. CYRTASPIS, Tuck. Champaign, Biddlecome, Spence.

61. C. FLACCIDUM, Ach. Champaign, Spence.

62. C. NIGRESCENS (Huds.) Ach. Champaign, Biddlecome, Spence, on bark, Werner.

63. C. PYNCNOCARPUM, Nyl. Springfield, Biddlecome.

64. COLLEMA RYSSOLEUM, Tuck. Springfield, Biddlecome.

65. C. TENAX (Sw.) Ach. Springfield, Biddlecome.

LEPTOGIUM, Fr.

66. L. LACERUM (Sw.) Fr. Springfield, Biddlecome; Marion, Bogue.

67. L. MYOCHROUM (Ehrh.) Tuck. Springfield, Biddlecome; Ashtabula, Bogue.

68. L. MYOCHOUM (Ehrh.) Tuck. var. SATURNINUM (Sm.) Schaer. Springfield, Spence.

69. L. PULCHELLUM (Ach.) Nyl. Common on trunks.

70. L. TREMELLOIDES (L. fil.) Fr. On sandstone rocks, Fairfield, Werner.

PLACODIUM, D. C.

71. P. AURANTIACUM (Light) Naeg. and Hepp. On bark, Painesville, Werner; Ashtabula, Bogue.

72. P. CAMPTIDIUM, Tuck. "Miss Biddlecome." N. A. Synop.

73. P. CERINUM (Hedw.) Naeg. and Hepp. Champaign, Biddlecome, Spence; Ashtabula, Fairfield, Franklin, Marion, Bogue.

74. P. FERRUGINEUM (Herds.) Hepp. Frequent on old fences and rock.

LECANORA, Ach.

75. L. CERVINA (Pers.) Nyl. On trunks and rails, Lea (Cat.).

76. L. HAGENI, Ach. Champaign, Biddlecome, Spence.

77. L. MACULATA, Ach. Champaign, Biddlecome.

78. L. PALLESCENS (L.) Schaer. Frequent on trunks, especially Chestnut.

79. L. PALLESCENS (L.) Schaer. var. ROSELLA, Tuck. Champaign, Biddlecome; trunks, Lea (Cat.).

80. L. PALLIDA (Schreb.) Schaer. Frequent on trunks.

81. L. PRIVIGNA (Ach.) Nyl. On sandstone, Fairfield, Kellerman, Werner; Summit, Bogue.

82. L. SUBFUSCA (L.) Ach. Frequent on trunks.

83. L. SUBFUSCA (L.) Ach. var. DISTANS, Ach. On trunks, Lea (Cat.).

84. LECANORA TARTAREA (L.) Ach. Champaign, Biddlecome, Spence; Fairfield, Werner.

85. L. VARIA (Ehrh.) Nyl. On old rails, Lea (Cat.); Fairfield, Franklin, Licking, Summit, Bogue.

RINODINIA, Mass.

86. R. SOPHODES (Ach.) Nyl. var. ATROCINEREA, Nyl. On trunks and rails, Lea (Cat.); Ashtabula, Bogue.

PERTUSARIA, DC.

87. P. COMMUNIS, DC. Springfield, Biddlecome; on rocks, Fairfield, Werner; Ashtabula, Bogue; on Blue Beech, Franklin, Bogue.

88. P. LEIOPLACA (Ach.) Schaer. Springfield, Biddlecome; on Maple, Painesville, Werner; on Butternut bark, Fairfield, Franklin, Bogue.

89. P. MULTIPUNCTA (Turn.) Nyl. Springfield, Biddlecome; on trunks, Lea (Cat.).

90. P. PERTUSA, Fr. Springfield, Spence; on trunks, Lea (Cat.); on bark, Franklin, Bogue.

91. P. PUSTULATA (Ach.) Nyl. On Blue Beech, Franklin, Bogue.

92. P. VELATA (Turn.) Nyl. Springfield, Biddlecome; Fairfield, Kellerman; Champaign, Werner; Ashtabula, Franklin, Bogue.

TRIBE 2. LECIDEACEI.

CLADONIA, Hoffm.

93. C. CARIOSA (Ach.), Spreng. Fairfield, Bogue.

94. C. CÆSPITICIA (Pers.), Fl. Summit, Lorain; on rotten wood, Franklin, Bogue.

95. C. CORNUCOPIOIDES (L.), Fr. John L. Riddell (Synop., 1835); Fairfield, Bogue.

96. C. CORNUTA (L.), Fr. On rotten trunks, Lea (Cat.).

97. C. CRISTATELLA, Tuck. Common on the earth.

98. C. DEGENERANS, Floerk. Fairfield, Bogue.

99. CLADONIA DELICATA (Ehrh.), Floerk. Springfield, Biddlecome, Spence; Fairfield, Bogue.

100. C. FIMBRIATA (L.) Fr. Common on the earth.

101. C. FIMBRIATA (L.) Fr. var. ADSPERSA, Tuck. Champaign, Spence.

102. C. FIMBRIATA (L.) Fr. var. TUBÆFORMIS, Fr. On rotten wood and the earth.

103. C. FURCATA (Huds.) Fr. Champaign, Biddlecome, Spence.

104. C. FURCATA (Huds.) Fr. var. CRISPATA, Floerk. Champaign, Biddlecome.

105. C. FURCATA (Huds.) Fr. var. RACEMOSA, Fl. On the earth, very common.

106. C. FURCATA (Huds.) Fr. var. SUBULATA, Fl. On the earth, Lea (Cat.).

107. C. GRACILIS (L.) Nyl. Champaign, Biddlecome, Spence.

108. C. GRACILIS (L.) Nyl. var. HYBRIDA, Schaer. On the earth, Ashtabula, Bogue.

109. C. GRACILIS (L.) Nyl. var. VERTICILLATA, Fr. On the earth, Fairfield, Werner, Bogue; Ashtabula, Bogue.

110. C. MACILENTA (Ehrh.) Hoffm. Champaign, Biddlecome, Spence; rotten trunks, Lea (Cat.).

111. C. MITRULA, Tuck. Springfield, Champaign, Biddlecome; Fairfield, Bogue.

112. C. PAPPILLARIA (Ehrh.) Hoffm. var. MOLARIFORMIS, Hoffm. Fairfield, Bogue.

113. C. PYXIDATA (L.) Fr. On the earth, common.

114. C. RANGIFERINA (L.) Hoffm. In mats on the earth, common.

115. C. RANGIFERINA (L.) Hoffm. var. a. On the earth, Fairfield, Bogue.

116. C. RANGIFERINA (L.) Hoffm. var. SYLVATICA, L. On rotten trunks, Lea (Cat.).

117. C. SQUAMOSA, Hoffm. On the earth, rocks and rotten wood. Common.

118. C. SQUAMOSA, Hoffm. var. VENTRICOSA, Fr. Fairfield, Bogue.

119. C. SYMPHYCARPA, Fr. var. EPIPHYLLA (Ach.) Nyl. Fairfield, Bogue.

BIATORA, Fries.

120. B. CINNABARINA (Smf.) Fr. On trunks, Lea (Cat.).

121. B. EXIGUA (Chaub.) Fr. G. On bark, Franklin, Werner.

122. B. FUSCORUBELLA (Hoffm.). Champaign, Biddlecome, Spence; on trunks, Lea (Cat.).

123. B. RUBELLA (Ehrh.) Rabenh. On Hickory bark, Painesville, Werner; on Linden, Franklin; on Beech, Ashtabula, Bogue.

124. B. RUSSELLII, Tuck. Springfield, Biddlecome.

125. B. RUSSULA (Ach.) Mont. Springfield, Spence.

126. B. SCHWEINITZII, Fr. Springfield. Biddlecome; on Oak bark, Fairfield, Bogue.

127. B. SUFFUSA, Fr. Springfield, Biddlecome; on trunks, Lea (Cat.).

HETEROTHECIUM, Flot.

128. H. LEUCOXANTHUM (Spreng.) Mass. On Acer saccharum, Columbus, Bogue.

LECIDEA, Ach.

129. L. ALBOCÆRULESCENS (Wulf.) Schaer. On rocks, Fairfield, Werner, Bogue; Ashtabula, Bogue.

130. L. CONCENTRICA, Dav. On rocks, Fairfield, Kellerman; Madison, Werner; Ashtabula, Bogue.

131. L. GRANOSA, Tuck. Ohio, Miss Biddlecome; Tuckerman's, Synop.

BUELLIA, De Not.

132. B. COLLUDENS, Nyl. Fairfield, Kellerman.

133. B. PARASEMA (Ach.) Th., Fr. On trunks, common.

134. B. PETRÆA. On rocks and stones, Ashtabula, Fairfield, Summit, Bogue.

TRIBE 3. GRAPHIDACEI.

LECANACTIS (Eschw. Kbr.) Tuck.

135. L. PREMNEA (Ach.) Tuck. var. CHLOROCONIA, Tuck. Marion, Bogue.

OPEGRAPHA, (Humb.) Ach. Nyl.

136. O. ATRA, Fr. var. MACULARIS, Fr. On trunks, Lea (Cat.).

137. O. SCRIPTA, Ach., Schaer var. LIMITATA, Schaer. On trunks, Lea (Cat.).

138. O. SCRIPTA, Ach., Schaer var. SERPENTARIA, Schaer. On trunks, Lea (Cat.).

139. O. VARIA (Pers.) Fr. On Maple, Warren, H. A. Surface; on old Elm bark, Franklin, Werner.

140. O. VARIA, Pers. Fr. var. PULICARIS, Fr. On trunks, Lea (Cat.).

141. O. VULGATA (Ach.) Nyl. Dayton, Biddlecome.

GRAPHIS, Ach.

142. G. SCRIPTA, Ach. On trunks, very common.

ARTHONIA, Ach.

143. A. ASTROIDEA, Ach. Champaign, Biddlecome, Spence; Franklin, Werner.

144. A. DESPERSA, Nyl. Springfield, Spence.

145. A. LECIDEELLA, Nyl. Springfield, Spence; on Honey Locust, Franklin, Kellerman.

146. A. POLYMORPHA, Tuck. On trunks, Lea (Cat.); on Maple, Madison, Werner.

147. A. PUNCTIFORMIS. On Acer rubrum, Ashtabula, Bogue.

148. A. PYRRHULA, Nyl. Springfield, Spence.

149. A. SPECTABILIS, Fl. On trunks, common.

TRIBE 4. CALICIACEI.

ACOLIUM, Fée.

150. A. TIGILLARE (Ach.) De Not. Columbus, Werner.

CALICIUM, Pers.

151. C. BYSSACEUM, Fr. On old Polyporus, Fairfield, Kellerman.

152. CALICIUM CRYSOCEPHALUM (Turn.) Ach. Atl. On Oak bark, Fairfield, Bogue.

TRIBE 5. VERRUCARIACEI.

ENDOCARPON, Hedw.

153. E. MINIATUM (L.) Schaer. Springfield, Biddlecome, Spence; on limestone rocks, Georgesville, Franklin County, Bogue.

154. E. PUSSILUM (Hedw.). Springfield, Biddlecome.

TRYPETHELIUM, Spreng.

155. T. VIRENS, Tuck. Springfield, Spence.

SAGEDIA, Mass.

156. S. OXYSPORA (Nyl.), Tuck. On Beech bark, Fairfield, Kellerman.

VERRUCARIA, Pers.

157. V. NIGRESCENS (Pers.), Atl. On rocks, Lea (Cat.).

158. V. MURALIS, Ach. On limestone rocks, Madison, Werner.

159. V. RUPESTRIS. On limestone rocks, Muskingum, Werner; on rock, Ashtabula, Bogue.

PYRENULA, Ach.

160. P. EPIDERMIDIS, Fr. On trunks, Lea (Cat.).

161. P. GEMMATA (Ach.), Naeg., Atl. On Beech, Oberlin, Bogue.

162. P. GLABRATA (Ach.), Mass. On old bark, Rendville, Perry County; Fairfield, Kellerman; Champaign, Werner.

163. P. ERITIDA, Ach. On bark, common.

164. P. STERILIS. On Beech bark, Morgan, Werner.

165. P. SUBELLIPTICA, Tuck. Trunks of Honey Locust, Lea (Cat.).

166. P. THELAENA? On Acer saccharum, Painesville, Werner.

LEAF-VARIATION — ITS EXTENT AND SIGNIFICANCE.

MRS. W. A. KELLERMAN.

Read at Meeting of Ohio Academy of Science, Dec. 29, 1892.

The voice of Nature is, perhaps, nowhere more potently heard than in her unpruned gardens, her fertile meadows and woodland hills. She speaks, however, not only through the general beauty of the landscape, but also through the leaves of every plant that grows, affirming through them the universality of the law of evolution, by emphasizing its underlying principle, "from the simple to the complex."

The herbs of the garden, the plants on the lawn, the shrubs and trees on every side, all indicate, by the variation of their leaves from typical forms, that they are not cast in a mold from which there is no deviation. Take, for example, the leaves of the potato, tomato, the dahlia, the elder, the blackberry, the walnut, the Liriodendron, etc., etc. The more carefully they are studied, and the more closely they are observed, the greater the degree of variation found existing between the leaves of any one plant. The leaves of the Liriodendron especially are considered as subject to slight, if indeed any, variation. Careful study of them, however, has brought to light some exceedingly interesting forms, many of which vary so much from the present typical leaves, that they would scarcely be considered as belonging to the same species. Had they been found as fossils, no doubt paleontologists would have coined specific names for each one of them.

In the Spring, when the sleeping forests have burst forth into new life, and the beautiful leaves again clothe the barren branches; when the little seedling plants have pushed their way through the mellow soil, there is abundant opportunity for studying leaf-variation.

The graceful leaves of the walnut; the rich glossy leaves of the oak; the beautifully serrated leaves of the chestnut; the truncate leaves of the Liriodendron; the conspicuously lobed leaves of the Liquidamber, and hosts of others, sway in unison with the breeze, exciting both interest and admiration. But, turn from the trees to the tiny seedlings round about; how different are their leaves from those of the great parent trees which tower above them. Instead of the frond-like, pinnate leaves, the seedling walnut at first bears only simple ones. The serratures on the first leaves of the seedling chestnut are mostly wanting; the tiny oaks bear lobeless leaves. In the seedling Liquidamber, the first pair of leaves above the cotyledons (Fig. 1) are very different from those of the young tree (Fig. 2).

The first pair of leaves above the cotyledons, in the seedling Liriodendron (Fig. 3), vary quite as much from the typical leaf (Fig. 4), the first leaves of the seedling being always less complex than those of the adult plant.

The variation in the leaves of herbs follows this same trend. Take, for example, Trillium grandiflorum, which, at maturity, or in the adult form, bears three leaflets. The little seedling we find with but a single leaf, which is borne upon a long, slender petiole or rootstalk (Fig. 5). It climbs no higher during the first year's growth than this stage, with the single leaf. The second year it bears two leaflets (Fig. 6), but not until the third year do we find the plant with the normal three leaflets. The common mandrake or May apple, Podophyllum peltatum, we may take as another example of the same law of development. The frail seedling during the first year bears but the cotyledons; two simple, entire, oval leaves (Fig. 11). The second year a pair of larger, irregularly notched leaves are produced (Figs. 8, 9, 10), which, perhaps, may be considered as partially foreshadowing the adult form. It is not, however, until the plant is three years old that it bears the common peltate leaf (Fig. 12).

What more clearly illustrates the development of the simple to the complex? Spencer says: "It is a law of heredity, that the immature young resemble their remote ancestors, while the adult resembles the immediate progenitors."

The young plant is no exception to this law. The first pair of leaves above the cotyledons are regarded as typical of the ancestral forms; these little seedlings bring with them representatives of bygone ages. The past and the present clasp hands, as it were, over the intervening years, through the seedling and the parent tree.

The variation of every leaf is probably initiated in the embryo bud. If the variation proves useful to the plant, natural selection takes it in hand, and the next generation of leaves becomes heir to each advance made; in the course of ages, the modification extends to the seed-germs themselves. The embryo seed-leaves are also advancing and represent a higher type. The parent plant, or tree, may become modified, and in this manner the difference between the ancestral type and the present would be constantly augmented.

The leaves of plants are short-lived; but each year gives them a fresh start from the bud, crowned with the inheritance of all previous time, and even though "the mills of the gods grind slowly," the outcome is variation from ancient forms. The adaptation of plants to changing conditions, necessitates variation of foliage. They must be able to obtain or appropriate food from the air; must secure to themselves all the sunlight possible; must be able to withstand wind and storm. Each of these three requisites is more readily attainable if the leaves are lobed, divided, or small, as in compound or pinnate leaves. It is plainly evident to anyone that the air can circulate more freely about a plant which has finely divided leaves; that it flows over and through them in such manner as to come in contact, not only with the outer, more exposed leaves, but with each lobe or leaflet of the entire plant. The sun light also penetrates through the whole mass of foliage more perfectly if the leaves are finely divided. The common horse-radish, Nasturtium Armoracia, may be taken as an illustration of the variation of foliage consequent upon changing conditions. Every one is familiar with the large, thrifty, vigorous leaves of this common plant, but, perhaps, not every one has observed that in the late Summer a manifest change is initiated in the foliage. The rank growth of the plant has produced a mass of leaves, which are crowded so closely together that the air circulates but sluggishly

through them, and the sun light is partially excluded. This state of affairs means starvation to the new leaves, which continue to spring from the crowded interior, *unless they are able to adapt themselves to the changed conditions* resulting from this over-population. Therefore, as the over-crowding continues to increase, the new leaves become "cut pinnatifid." The transition from the large crenate leaves, to the cut-pinnatifid forms, may be observed by any one. The apex of the leaf first becomes cut, the lower portion of the leaf remaining normal. (?) Perhaps two months after the first appearance of these transition forms, the entire leaf has become transformed into a curiously cut-pinnatifid leaf. The large leaves are killed by the early frosts, while the cut leaves, which fill the crown, live through the Winter, and are apparently the growth of early Spring. They are, however, the late Fall growth instead, and are very soon superseded by the common large leaves when the real Spring growth begins, passing back through transition forms.

The variation in the leaves of the common blackberry, Rubus villosus, furnishes another example in which the Spring growth varies from that of the Fall. The leaves are indiscriminately described as having from three to five leaflets. The fruiting cane, however, never produces the quinquefoliate leaf; the tri-foliate form (Fig. 16) is the prevailing leaf on the lower portion of fruiting canes, while toward the extremity but a single leaf is found at the base of the fruit cluster (Fig. 16). The new canes produced during the Summer and Fall, for the next year's fruiting, bear leaves of from three to five leaflets. Various transition gradations occur so commonly (Figs. 14, 15,) on the latter as to be conspicuous to any one whose attention has been called to the subject. It is interesting to note that the veins become obliterated between these gradation forms, even when the division of the leaves is but begun, as indicated by the Figs. 14 and 15, also in 2 of the seedling. (Fig. 13.) But why should not the fruiting canes of the past year's vigorous growth also bear the quinquefoliate leaves and transition forms? Is it not because the force, which was expended in the previous Fall in the elaboration of the fruit buds, is now consumed in the production of fruit? Is not this a sort of natural method of pruning? Of hus-

banding force and energy in one direction that it may be more advantageously expended in another? The Fall growth of the plant, with its increased leafage, may be able to build up stronger fruit-bearing canes for the succeeding season. The quinquefoliate leaves and fertility in one and the same branch at least, seem, at present, incompatible. It is claimed that the fruiting branches of the Sassafras generally bear but the entire form of leaf. In poor conditions plants retrograde. In fruiting canes, or branches, the conditions for the production of leaves are not favorable. Their "specialty" is the elaboration of fruit, and the leaf force is diminished. The single or retrograde leaf on the fruiting cane approaches the single, simple leaves of the seedling plant (Fig. 13).

Leaf-variation is but a phase of the universal, onward march of all things. We no longer say "the everlasting mountains," for they rise and sink; the isles of the sea are born and disappear; change, change is written upon all that is, but nowhere is it more plainly inscribed than upon the foliage of herb, shrub, or tree.

NOTE.—The references are to Plate II.—*Ed.*

A REMARKABLE MALFORMATION IN A CAT

D. S. KELLICOTT, Columbus, Ohio.

Congenital malformations of an animal's body always attract the curious, and prove deeply interesting to the anatomist and the embryologist. The case described below was one of profound transposition of the thoracic and abdominal viscera—a phenomenon that is at least rare. The cat was an active, young adult, Maltese male. It was prepared for dissection in the usual way, by washing out the vascular system and injecting it with plaster from the femoral vessels. Miss Olla Buckman, a student in comparative anatomy, in preparing to trace the thoracic blood vessels, discovered that they were in abnormal positions. In short, it proved to be a case of malformation by transposition of visceral organs that was almost complete. This general statement might possibly suffice, but a detailed statement is added in the hope that it may prove more useful for future reference.

The axis of the heart made the usual angle with that of the body, but had the apex directed toward the right side and the base to the left; the venous side of the heart was ventro-sinistrad and the arterial dorso-dextrad. The aortic arch, slightly shortened in consequence of the heart's position, turned to the right and passed caudad on that side of the vertebral centra; the order of branches from the arch were also reversed, *i. e.*, the right subclavian arose independently and the left subclavian from the brachio-cephalic, as the right usually does, just caudad of the origin of the carotids. The brachio-cephalic was abnormally short, not exceeding half the usual length. The postcava and precava were on the left side, as a matter of course, but otherwise normal; the azygous vein was on the left side also.

The lungs likewise shared in the reversal. In the cat there are three chief lobes in each lung with a small azygous lobe on the right; in this instance it was attached to the left lung.

The changes necessitated in the position and perforation of the diaphragm, due to the shifted organs, may be readily inferred. Among the transposed abdominal organs were the following: the stomach and spleen were on the right, in correct relation and position otherwise; the liver on the left; and the duodenum and the land marks of the intestines were all reversed in position. The left kidney proved to be considerably cephalad of its fellow, thus again reversing the usual order, and the arrangement of renal arteries and veins for each side was that of the other.

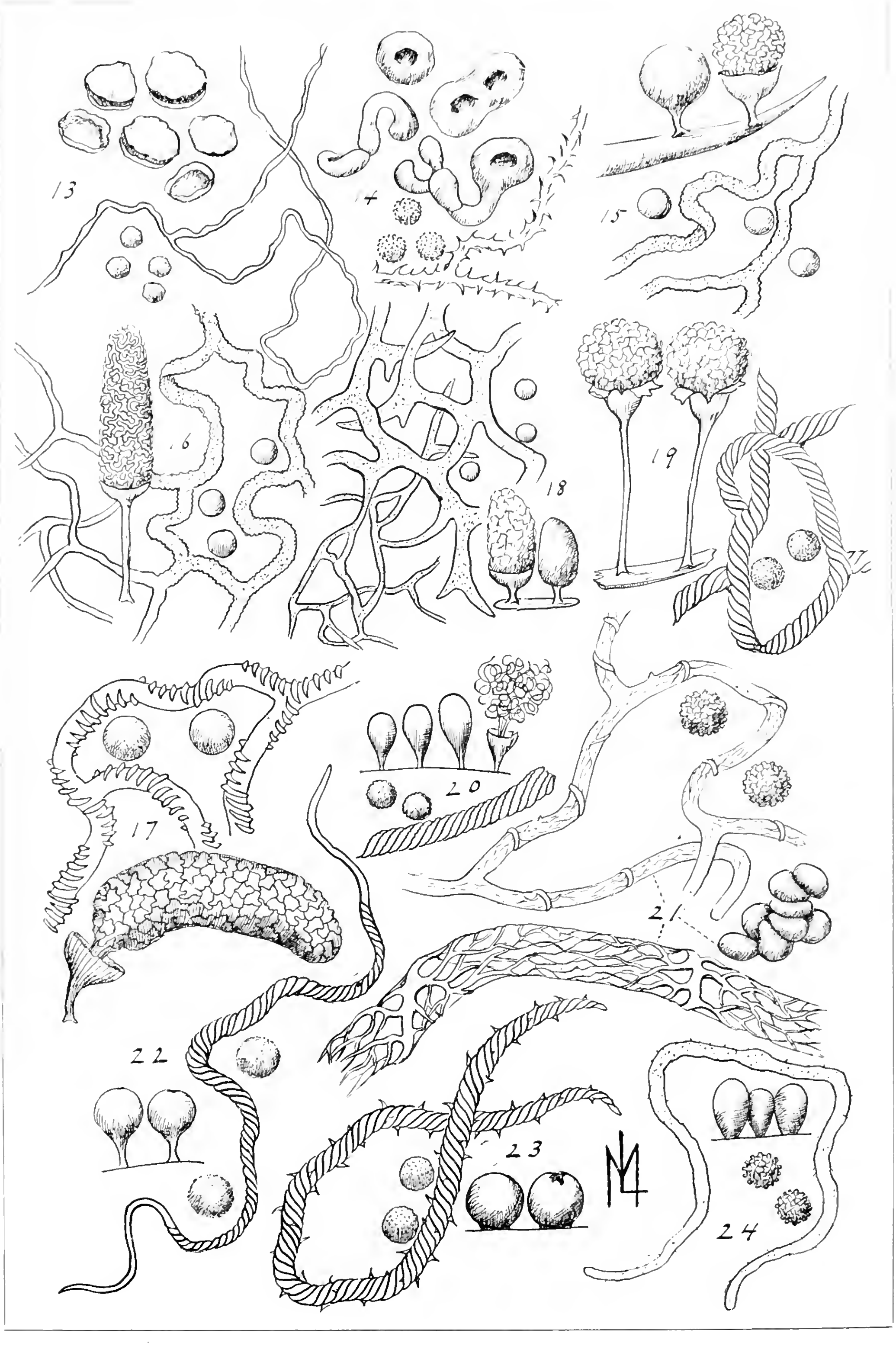
The great nerves traversing the thorax were also reversed, as regards relation to organs and branching.*

*Note.—Since the above was written, I have received, through the kindness of Mr. C. P. Sigerfoos, a Bulletin of Johns Hopkins Hospital, Vol. IV, No. 28, containing a record of a similar peculiarity in a dog found in the Biological Laboratory of the University, and reported by Theodore Hough. D. S. K.

EXPLANATION OF PLATE I.

Fig. 13.— Perichaena depressa, Lib.
Fig. 14.— Ophiotheca Wrightii, B. & C.
Fig. 15.— Lachnobolus globosus, Schw.
Fig. 16.— Arcyria Cookii, Massee.
Fig. 17.— Arcyria minor, Schw.
Fig. 18.— Heterotrichia Gabriellæ, Massee. (After Massee.)
Fig. 19.— Hemiarcyria plumosa, Morgan.
Fig. 20.— Hemiarcyria funalis, Morgan.
Fig. 21.— Calonema aureum, Morgan.
Fig. 22.— Trichia fallax, Pers.
Fig. 23.— Trichia scabra, Rost.
Fig. 24.— Oligonema flavidum, Peck.

NOTE.— Each figure exhibits the sporangium as it appears magnified about 100 diameters, and the capillitium and spores magnified about 500 diameters.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EXPLANATION OF PLATE II.

Fig. 1.— Germinating plantlet, Liquidamber styraciflua, L.

Fig. 2.— Leaf from Liquidamber tree five or six years old.

Fig. 3.—Germinating plantlet, Liriodendron Tulipifera.

Fig. 4.— Typical leaf of Liriodendron Tulipifera.

Figs. 5, 6, 7.— First, second and third year's growth of Trillium grandiflorum.

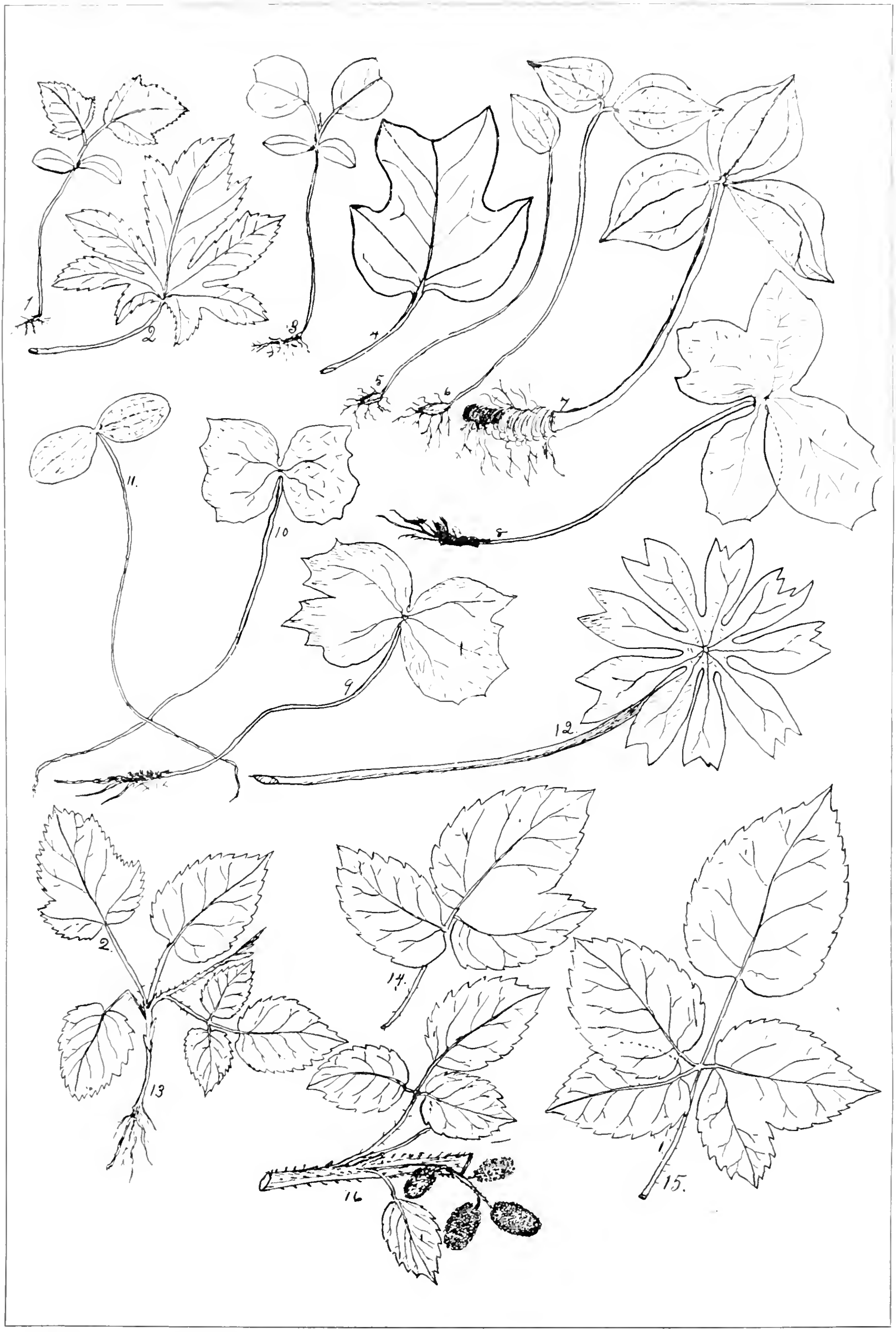
Figs. 8–12.— Podophyllum peltatum; 11, first year's growth; 8, 9, 10, growth of second year; 12, peltate leaf, which does not appear until third year.

Fig. 13. Seedling Rubus villosus, showing that the first leaves to appear are simple.

Fig. 14.— Leaf of R. villosus, showing a transition stage preceding the common trifoliate form.

Fig. 15.— Leaf of same, illustrating the development of the quinquefoliate, from the trifoliate form.

Fig. 16.— A portion of a fruiting cane, of R. villosus, with trifoliate, and simple leaves at base of fruit clusters. (The simple leaf alone being found toward extremity of cane.)



MRS. W. A. KELLERMAN, Del. ad nat.

THE JOURNAL

OF THE

Cincinnati Society of Natural History.

VOL. XVI. CINCINNATI, JULY-OCTOBER, 1893. NOS. 2 & 3.

PROCEEDINGS.

May 2, 1893.

The regular May meeting of the Society was called to order, with President Collier in the chair, at 8.15 P. M.

The minutes of March 7 and April 4 were read and approved, after the Secretary had been instructed to insert in the minutes of April 4 a report of the President's remarks made at that meeting.

The following applications for active membership were read and ordered posted for the usual time, to-wit: Joseph Kirkup, Thomas J. Foy, H. J. Groesbeck, L. R. Myers and W. F. Robertson.

The following papers were read by title and referred to the Publishing Committee, to-wit:

The Myxomycetes of the Miami Valley. Second Paper. By Prof. A. P. Morgan.

Leaf variation, its extent and signification. By Mrs. W. A. Kellerman.

Lichens of Ohio. By E. E. Bogue.

Notes on a Malformation of a Cat. By Prof. S. A. Kellicott.

Mr. William Hubbell Fisher then read a very interesting and instructive paper upon "The underground homes of the Marmot." It was profusely illustrated by lantern slides, consisting of photographs of the surroundings and entrances to the burrows, as well as diagramatic representation of their form, direction and size.

Adjourned.

DONATIONS.

SPECIMENS.

Dr. O. D. Norton, Ostrich Egg (Rhea rhea).

Dr. Arch. I. Carson, from estate Dr. William Carson, three Mounted Bird Skins.

T. H. Kelley, case of Mounted Bird Skins, consisting of fifty specimens of the Hamilton County, Ohio, fauna.

Dr. William L. Mussey and Trustees Miami Medical College, for the estate of R. D. Mussey, eight cases of birds (50) and a few mammals.

Books and pamphlets from Dr. Arch. I. Carson, for estate of Dr. Wm. Carson.

BOUND VOLUMES.

Science, Vols. XI to XIV.

Nature, Vols. 44 and 45.

Reports Ohio Meteorological Bureau, 1882–83 and 1883–84.

Appalachia, Vols. I to V.

American Meteorological Journal, Vols. I to IV.

Ohio Statistics, 1877 (two copies) and 1878.

Geological Survey of Ohio; Geology, Vols. I and III; Economic Geology, Vol. V; Palæontology, Vol. I; Maps, 1873, (two copies); Geological Atlas of State of Ohio.

Ohio Centennial Report.

Ohio School Report, 1879.

Ohio Agricultural Reports, 1877 and 1883.

Report of Commissioner of Labor, 1889.

Bulletin U. S. Fish Commission, Vols. II and III.

U. S. Fish Commission, Propagation of Food Fishes, Reports 1873 to 1876 and 1881 and 1882.

Annual Reports of Cincinnati, 1872.

Water Power of Maine, Hydrographic Survey of Maine, 1869.

Smithsonian Reports, 1878, 1879 and 1888.

Marine Surveying, U. S. Naval Academy.

Topographical Survey of the Adirondack Wilderness of New York, 1873.

Report of Chief Signal Officer, 1872.

Diseases of Cattle in U. S., U. S. Department of Agriculture, 1871.

Daily Bulletin Signal Service, U. S., 1872.

Smithsonian Temperature Tables, 1876.

Smithsonian Contributions to Knowledge, Vol. XX.

Report on Cattle Plague, London, 1866.

Hittell's Hand-book of Pacific Coast Travel.

Pocket Atlas of U. S., Climatic Maps.

American Ephemeris and Nautical Almanac, 1881 and 1886.

Rainfall in the U. S., Dunwoody, 1883.

Explorations for railroad route from the Mississippi to the Pacific, Vols. I, V and XI.

Ninth Census of U. S., Vital Statistics.

PAMPHLETS.

U. S. Department of Agriculture, Forestry Division, Bulletin No. 7.

Science, Vols. I to X, inclusive; missing, II, Nos. 39 and 40; IV, No. 99; VIII, No. 178, and X, No. 233.

Nature, Vol. 43; No. 13 to 26, inclusive; No. 21 missing; 46 complete; 47, No. 1 to 9, inclusive.

Reports Ohio Meteorological Bureau, 1885 to 1892, inclusive, missing, 1885, September; 1886, Annual Report; 1887, Annual Report, July, October, November and December; 1888, January, February, March, April, July and September; 1889, August; 1890, October; 1891, May and September; 1892, Annual Report, April to December.

American Meteorological Journal, Vols. II (No. 9 missing), III (No. 9 missing), IV (No. 3 and 12 missing), VI (No. 9, 10 and 11 missing), VII, VIII and IX (No. 1 duplicated and No. 9 missing).

Appalachia, Vols. VI and VII (Nos. 2, 3 and 4 missing).

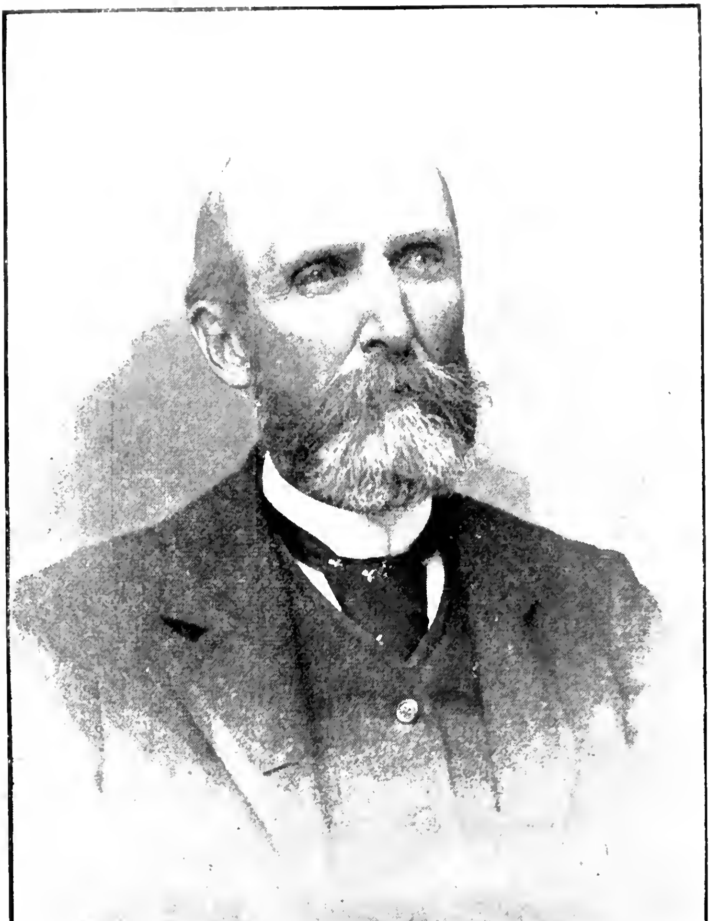
DR. WILLIAM CARSON.*

Dr. William Carson was born at Chillicothe, Ohio, November 25, 1827, and died at his home, in Cincinnati, July 9, 1893. His natural inclinations and education as a physician led him to develop a taste for the natural sciences, which was a source of constant pleasure and relaxation to himself and his friends during a long and arduous professional career. He became a member of the Cincinnati Society of Natural History in 1873, taking especial interest in the Photographic Section (the successor of the "Camera Club," of which he was a founder, and president for several terms); and was noted for the quiet enthusiasm with which he successfully pursued his favorite art. He also participated in the active work of this Society as a lecturer, appearing on the platform as a contributor to its free courses of scientific lectures.

Of a somewhat retiring disposition, and reserved in his intercourse with strangers, his life was characterized by a warmth of feeling and depth of thought that strongly attached to him a wide circle of friends. Dr. Carson was an enthusiastic lover of nature, and was never more happy than when "roughing it" on lake or mountain, far from the conventionalities of civilized life. In his profession no man stood higher. He was constantly in demand as a consultant. His services to the profession and the public were attested by his election to the presidency of the Academy of Medicine and Cincinnati Medical Society, as well as by his work on the staffs of the Cincinnati Hospital, St. John's and Good Samaritan Hospitals, and the Episcopal Hospital for Children. He was also a member of the Ohio Sons of the Revolution, by reason of the fact that his grandfather, Captain Abraham Claypole, had been a revolutionary soldier.

The degree of LL.D. was conferred on Dr. Carson in 1892 by his alma mater, the Miami University.

*The portrait of Dr. Carson prefixed to this number has been kindly furnished, without charge, by Mr. James Barclay.



DR. WILLIAM CARSON.

Dr. Carson has lived in the house where he saw his last, 138 E. Third street, for the past thirty years, and has there reared his family.

In 1854 he married Miss Louisa Whiteman, daughter of Louis Whiteman. In 1863, his former wife having died, he was married to Miss Esther A. Irwin, daughter of Archibald Irwin, of this city. She, too, died June 8, 1891.

The children are Miss Jane F. Carson, Mrs. James J. Faran, wife of Fire Commissioner Faran; Miss Mary C. Carson and Dr. Arch. I. Carson, who was associated with his father in practice. One other son, Louis Whiteman Carson, died an infant. The other relatives of Dr. Carson are two brothers and two sisters, Mr. Erskine Carson, of Hillsboro, who was at the bedside of his brother at his death; Mr. David Carson, of West Plains, Mo.; Mrs. S. F. McCoy, of Chillicothe; Miss Alice Carson, of Georgetown, D. C.

The death of a gentle, refined, upright and broad-minded intelligent citizen is a shock to every community correlative with his acquaintance in that community. Death emphasizes worth, hence a man's worth is only fully appreciated when he is stricken by the fell destroyer, however well his work and attainments when living may have been known. When that man has been identified in one place for upward of forty years in the practice of medicine, the power of good he has wrought is inestimable, and his loss is deplored, because of the certain knowledge to many that in life he possessed the demonstrated ability to help, to strengthen and to save.

By the death of Dr. Carson, the Cincinnati Society of Natural History loses one of its active and most valued members; the medical profession of Cincinnati is bereft of one who was an example of the highest type of the physician; and the community at large is deprived of the services of a broad-minded citizen, a wise counselor and an upright man. L.

STUDIES IN PROBLEMATIC ORGANISMS.

No. II.—The Genus FUCOIDES.*

BY JOSEPH F. JAMES, M. SC., F. G. S. A., F. A. A. A. S., ETC.

The literature dealing with "problematic organisms" is very extensive. From the year 1822, when the genus FUCOIDES was established, up to the present time, the number of species described is enormous. No complete bibliography on the subject has ever yet appeared, the only one of any extent being that of Nathorst, published in 1881.† This list gives 130 titles, but it is by no means complete, and many papers have appeared since it was printed. It is not the intention to give in this place a review of this vast mass of literature, instructive though it might be, but to take up the first genus to be proposed in any formal and scientific manner, and to give a history of it.

The genus FUCOIDES was first proposed and defined by Adolphe Brongniart in 1822.‡ In a table of the classes and genera of fossil plants we find the following description:

"Frond unsymmetrical, often disposed in an even plane, with nerves none or badly limited. (Pl. III, Fig. 3.)" In the course of the article the genus is mentioned several times. The following remarks occur on page 237:

"None of the authors who have written on fossil plants, I believe, speak of fossil Fuci, to which we give the name of

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*(NOTE).—No. 1, "The Genus Scolithus," was published in Bull. Geol. Soc. Am., vol. iii, 1891, pp. 32-44.

†Om spar af nagra evertebrerade djur m. m. och deras palæontologiska betydelse; accompanied by an abridged translation in French, "Memoire sur quelques traces d'animaux sans vertebres, etc., et de leur portée paléontologique. Kongliga Svenska vetenskaps-Akademiens Handlingar for 1880 No. 7.

‡Sur la classification et la distribution des végétaux fossiles en général, et sur ceux des terrains de sédiment supérieur en particulier. Mem. Mus d'Hist. Nat., vol. viii, Paris. 1822, p. 210.

FUCOIDES.* There is not, nevertheless, the least doubt of the analogy of the greater number of these plants with those of the family of Algæ; this analogy is so evident that we have determined to unite in one genus all the fossils that appear to have belonged to the family of non-articulate Algæ, though the variable forms presented by the plants of this order render the characters of the fossil genus difficult to establish. The whole of these characters give, however, to these vegetables a sufficiently distinct aspect to prevent them being confounded with any other fossil plant."

The next reference is as follows:

"FUCOIDES:—I do not enter here into details of the species of *Fucoides* of the upper sedimentary terrane, since I will do this in a special work, wherein will be given the *Fucoides* of various terranes; a work in which M. Agardh has kindly offered to aid me with his council, and to which the profound knowledge this celebrated botanist has of the plants of the family can give a very great degree of exactness.

"I shall here content myself with saying that the small number of species so far observed in the upper sedimentary terrane appear to agree sufficiently with established genera of the family, and that some species very closely resemble even living species.

"It is principally at Monte Bolca, near Verona, that these fossils have so far been discovered." (pp. 307–308.)

The last reference to the genus in the paper describes the localities where the fossils had been found,† but as this is discussed more fully in the next paper to which we shall refer, the matter will not be entered into here.

The joint paper alluded to, by Brongniart and Agardh, does not seem to have ever been published, but the subject was taken up again by Brongniart the following year. As this second paper is of considerable importance, and is not readily accessible to many, we shall give the preliminary remarks in full, with a mention of the species described. The description of the type species will also be given.

"* Fucoides strictus, Agardh, ined., pl. III, fig. 3. This fossil has been found in beds of lignite, discovered in the island of Aix near Rochelle, by M. Fleurian de Bellevue. It forms part of a work that M. Agardh has kindly undertaken with me on the fossil plants of the family of Algæ."

†Ibid., pp. 335–336.

OBSERVATIONS ON FUCOIDES AND ON SOME OTHER FOSSIL MARINE PLANTS. — By Ad. Brongniart. Read January 31, 1823.*

FUCOIDES.

It is only within a short time that naturalists have commenced to give attention to fossil plants of the family Algæ that are met with in different terranes; of the few, I do not know one old work in which they are mentioned in an exact manner. It seems, however, that these fossils, very common in many parts of Italy, as will be shown later on in this memoir, have attracted the attention of some Italian botanists, and particularly the celebrated Micheli and Jean Targioni.

Brocchi is said† to have found among the manuscripts of the latter, a very excellent work on the Fuci that he found in some calcareous rocks named in Tuscany, *Galestro* or *Querceto*, about seven miles from Florence; but this work, accompanied by 44 plates, unfortunately remains in manuscript, and is, in consequence, unknown to nearly all naturalists. It appears, however, from what Brocchi has said, that the Fuci brought together by him include some species described by us in this memoir; we imagine, however, from the number of plates accompanying the work, that Targioni had many more species than we have knowledge of.

Turner, in his superb work on the Fuci, vol. 2, p. 75, in the article on *Fucus ligulatus*, says that Dr. Scott had told him of the discovery of impressions of this species of Fucus in the basalt of the Chaussee-des-Geauts; but the information is too vague for one to place great confidence in the observation, because there have not been discovered, up to the present, any organized fossil bodies, and especially vegetable, in the basalt.

Finally, last year, M. Schlotheim, in a supplement to his work on petrefactions,‡ has made known, under the name of *Algacites*, some fossils that approach the Algæ or marine plants, and of which he had not spoken in his previous work. At the same time the supplement appeared in Germany, I

*Mem. de la Soc. Hist. Nat. de Paris, vol. 1, 1823, pp. 301-321, pl. 3.

†Bibliotheca Italiana, vol. x, p. 206.

‡Nachträge zur petrefactenkunde, von E. F. Baron von Schlotheim, Gotha, 1822.

pointed out in a paper published in the Memoirs of the Museum* this group of fossil vegetables under the name of *Fucoides*, and I announced then the work that I publish now.

The examination that M. Agardh gave to these fossils at the time of his stay in Paris, (in January, 1821,) and the observations that he has been good enough to communicate on the subject, certainly add greatly to this notice. Thus, I have carefully indicated by the words *Ag. Mss.* the species I have been able to submit to this able botanist, who has made a special study of the family of Algæ. These species have been mentioned by him in the *Species Algarum*, of which he has published the first volume; but during this period the number of species that I know has been greatly increased, and it is possible, that when careful search has been made in the places where some have already been found, a much larger number may be distinguished.

I have not spoken in this memoir of the so-called Confervæ found in crystals of quartz, not having had occasion to examine them myself; I can do no more than report what authors have said, and I prefer in this case to refer to a memoir published on this subject by M. J. MacCulloch in the Geological Transactions,† where very good figures will be found. I would remark, however, that if these singular branchings are really the remains of vegetable organisms, they should form a special genus among fossil plants; one in which we shall be able to place all the fossil confervoid vegetables having articulated filaments.

In addition to the species observed by myself, I am indebted for five figures to M. Schlotheim, given under the names of *Algacites crispiformis*, *filicoides*, *granulatus*, *orobiformis* and *frumentarius*, in the work already cited; but among these fossils only the first species I believe may be placed among the plants evidently belonging to the family of Algæ; the others appear to me to differ so widely from the living Fuci, that I have grouped them at the end with some other doubtful species that I have not cared to place positively in this family. It is easy to see how difficult it is to fix accurately

*Sur la classifi. et la distri. des Veget. fossiles. Mem. du Mus., vol. viii.

†On vegetable remains preserved in Chalcedony, by J. MacCulloch, M. D. Trans. of the Geol. Soc., vol. ii, Lond., 1814. p. 510.

the limits of a family when the living genera and species present so many variations in their forms and aspects, even when one is familiar with the more important characters establishing the exact similarity, such as the internal organization and the mode of fructification, characters that we can never observe in the fossils. In these, one is confined to external characters, that show the appearance, the form and the general aspect of the plant after it has passed into a fossil state. We believe, however, that all the world is in accord with us in placing in the family of non-articulate Algæ the species that we have placed with certainty in this family. Among those we have put with doubt at the end of the genus *Fucoides*, there are only two that I have seen for myself, and their form is so singular that we have not placed them with certainty among the marine plants; we do not know the four others, except from the figures of M. Schlotheim, and we have already said of these figures that they differ so widely from all the Algæ described and figured by botanists, that we doubt much their forming part of this family.

While there seems to us little doubt as to the position the fossils that we describe in this memoir should occupy in the vegetable kingdom, it is not the same with the distinction of species; in reality, nothing can be more embarrassing than to tell which of these fossil bodies, generally very variable in the same species, should be considered as species and which as varieties. It becomes much more difficult when one must often decide for himself from few specimens; we believe, therefore, that when a great number has been observed, we may, perhaps, be obliged to unite many species in one. But for the present it has appeared more convenient to separate all that offer such distinct characters as to lead to the presumption that the fossils belong to different species.

In regard to the horizon of these vegetable fossils, it should be remarked that all those known at present belong to four different formations: 1. The *Fucoides* of Monte-Bolca, near Verona. I shall say nothing of this celebrated locality, my father having described it with details in the memoir he has published on the calcareous traps of Vicentin. I repeat only his statement, that this terrane is a sedimentary formation above the Tertiary, and I would remark that the fossil plants

are found not only in the same beds, but frequently on the same slabs, as the fish; so that all that has been said of the one applies as a consequence equally to the other.

The species that belong to this locality apparently come closest to, more so than any others, actually living species, and in general to those that grow in the temperate oceans. It is only necessary to except the two species we have placed with doubt in the genus *Fucoides*, under the names of *Fucoides discophorus* and *turbinatus* and *Fucoides agardhianus*, which, especially, approaches *Caulerpa*, and, in consequence, to a genus belonging almost entirely to the equatorial or southern oceans.

2. The fossil Fuci discovered in the lignite of the island of Aix, near Rochelle, by M. Fleurian de Bellevue, and for the knowledge of which I am indebted to that *savant* and to M. d'Orbigny. The lignite in which they are found has been indicated by my father as a type of the lower marine lignite of the chalk.* It does not contain any other determinable vegetables, except the leaves we describe in this memoir under the name of *Zosterites*. They appear to be composed almost entirely of these Fuci and of the stems of trees, among which I have not seen up to the present those of Dicotylodons. Besides the two species of *Fucoides* we describe in this memoir, there were included the debris of a great many species, too incomplete to be determined.

3. The species of *Fucoides* found in the limestones of Stonesfield, near Oxford, and of which M. Buckland has willingly given me a very correct plan. The beds here included belong, according to this celebrated geologist, to the calcareous oolite of the Jura. These beds contain, besides the *Fucoides*, plants that we have placed with *Lycopodites*,† and portions of leaves very probably belonging to ferns. These specimens of ferns, that I did not know of on the publication of my first work on fossil vegetables, occasion some modification of the information I have given of the fossil vegetables of the Jurassic limestone in which I had not then found the ferns, and proved that these vegetables are found again in the lower formations of the Coal terrane. The only

*See the article "Lignite," in the *Dictionnaire des Sciences Naturelles*.
†*Lycopodites bucklandi*. Mem. du Mus., vol. viii.

two species of *Fucoides* that I know of from this terrane, appear to belong to an almost entirely exotic genus, to the genus *Caulerpa* of Lamouroux, that does not exist in our seas, except one species, very different from the fossil species.

4. *Fucoides furcatus, recurvus, difformis, æqualis* and *intricatus* are found in a formation that is represented in many very remote places with nearly similar characters, but the position of which is not yet well fixed by geologists, and which my father presumed might belong, like those of the Island of Aix, to the lower lignites of the chalk.

Thus, *Fucoides intricatus* is found near the chateau of Malaspina, near Sarzana; in the marls accompanying the lignites quarried near Kaltenberg, to the north-east of Vienna, in Austria; and the hill west of Genoa, between St. Stephan and St. Morizzio, near Oneille, without one being able to establish the least difference between the Fucus forms themselves, or in the rocks in which they are enclosed.

Fucoides æqualis is found at Vernasque, in the Appenines; to the south of Fiorenzola, in the Plaisantin; and at Bidache, near Bayonne, in exactly similar marls.

Fucoides furcatus is represented at Vernasque; in the environs of Vienna, and near Sarzana.

Finally, *Fucoides recurvus* has been found thus far only at Vernasque, and *Fucoides difformis* only at Bidache.

But the perfect resemblance of the two other species, and those of the rocks in which they are contained, seems to have sufficiently established the analogy of these terranes. It is curious to note that these various species seemingly belong to one and the same section of this genus, and this renders it more difficult to well define their limits.

Having indicated the geological position in which these fossils are found, I shall now proceed to describe the species that I can refer to the genus *Fucoides*.

Fucoides.

Frond continuous, often membranaceous and spreading in the same plane; the two sides generally unequal; nerves more or less ill-defined, never regularly divided or anastamosing.

Obs.—The absence of characters deduced from the fructification or of the internal structure in these fossils, renders the characters of this group very vague; however, the absence of all vascular nerves and the continuity of the frond, are two essential characters of the Algæ that one finds in all the fossil species that we here describe; some of these present, it is true, a middle nerve, but this nerve is large, thick, badly defined, and never sends out regular secondary divisions.

It is quite evident from his remarks that, while Brongniart recognized the boundaries of the genus as vague and the limitations of the species difficult to state, he had no hesitation in placing it with the Algæ; and in many of his species he was correct, as later investigations have shown. The difficulty of the whole matter lies in the fact that authors, delighted to have some place in which to place the innumerable forms they felt sure were not of animal origin, referred them all to the vegetable kingdom and called them fucoids. Hence, we find under the genus FUCOIDES an *omnium gatherum*, which it has required the labors of many years to sift. This one genus has contained in its time upward of 100 species and varieties. Virtually, it now contains none, although, as we shall show later on, we believe at least one should be placed there. The species described by Brongniart, in 1823, are as follows:

Fucoides	orbignianus	Fucoides	gazolanus.	
	strictus.*		lamourouxii.	
	crispiformis.		agardhianus.	
	furcatus.		pennatula.	
	recurvus.		elegans.	
	difformis.		discophorus.	
	æqualis.		turbinatus.	
	var. flexilis.	Algacites	frumentarius,	Schlotheim.
	intricatus.		orobiformis,	"
	obtusus.		filicoides,	"
	flabellaris.		granulatus,	"

One of the laws of nomenclature requires that the first species of a genus proposed be taken as the type of that

*Although placed second here, this was the form mentioned in 1822 as the type of the genus.

genus. There can not be the least doubt in the present case that *strictus* was the first species described under the new generic name. This being the case, it is well to give the description of the species. It is as follows:

"FUCOIDES STRICTUS. — Frond linear, bifurcating, with the branches erect, fastigiate and close together; midrib broad, flattened, tuberculate and prominent, with undulate margins. (Pl. xix, Fig. 2.)

"*Sphærococcus? strictus* Ag. MSS.

"*Rhodomela? diluviana* Ag. Spec. Alg. I, p. 383.

"*Fucoides strictus* Ad. Br., Class. veg. foss., p. 37, tab. 3, fig. 3.

"Locality.—In the lignite of the Isle of Aix, near La Rochelle. (Fleurian de Bellevue, d'Orbigny.)

"This species resembles greatly in its general form *Fucus obtusatus* Labill., N. Holl., but it differs in the large and flat nerve that traverses the frond, and that fails entirely in *Fucus obtusatus*. The fossil species has a more rigid and fastigiate aspect. The arrangement of the nerve shows some analogy to *Fucus alatus*, but it differs greatly by its size and more erect and scattered branches. The generic position in the Algæ is very difficult to assign. It is probable that the tubercles observed on the middle nerve are the organs of fructification."

Further remarks upon this and other species of the genus will be deferred until later on in this paper.

In 1825 appeared volume one of a memoir by Sternberg, under the title of "Versuch einer geognostisch-botanischen darstellung der flora der vorwelt." In this numerous species of *Fucoides* are given, most of them from Brongniart. We find the genus broken up and the species referred to various sub-genera. These are taken from living genera which seem to bear the closest resemblance to the fossil forms. Among them are *Chondria*, *Sargassum*, *Caulerpa*, *Delesseria*, etc. A single new species seems to be described, viz: *Fucoides cylindricus*, while *F. granulatus* is used to replace *Algacites granulatus* Schloth.

The next publication bearing upon the subject was an important one. It was Brongniart's "Histoiré des végétaux fossiles, ou recherches botaniques et géologiques sur les

végétaux refermes dans les diverses couches du globe." The first volume, bearing date of 1828, treats of cryptogams, Algæ among them. In his introductory remarks the author says: "We give this name [Algæ] to all the aquatic cryptogams without articulations that form the two families *Ulvaceæ* and *Fucaceæ*, families that we have found in many cases difficult to distinguish in a fossil state, their characters being essentially in the arrangement of the reproductive bodies, and in the character of the tissue that composes their fronds, both characters that disappear very soon in fossil plants." He then proceeds to examine the characters of living Algæ, noting the distribution of various genera and their characters, but, before taking up the genus *Fucoides* and the species referred to it, he says: "We have not divided this family into distinct genera, mainly because the proper characters to exactly define them are very rarely apparent, and the classification can not be a precise one; but we have divided the general group of fossil Algæ, to which we have given the name of *Fucoides*, into sections founded on the form of the frond, sections that correspond quite exactly with one or more genera of living Algæ."

It is quite evident that Brongniart, while recognizing the diverse characters of the plants, also saw the difficulties in the way of arranging them in a satisfactory manner. The great diversity becomes very evident when the species described are studied in detail. The following is a list of the species in the sections given by the author. The new species are indicated by "n. sp.:"

I. Sargassites.

1. F. septentrionalis, (Ag.) sp.
2. F. sternbergii, n. sp.—*Algacites caulescens* Stern., and *F. bohemicus* Stern.

II. Fucites.

3. F. strictus, Br.

III. Laminarites.

4. F. tuberculosus, n sp.

IV. Encoelites.

5. F. encoelioides, n. sp.

V. Gigartinites.

6. F. targionii, n. sp.
7. F. difformis, Br.
8. F. æqualis, Br.
9. F. intricatus, Br.
10. F. obtusus, Br.
11. F. stockii, n. sp.
12. F. recurvus, Br.
13. F. furcatus, Br.
14. F. antiquus, n. sp.

VI. Delesserites.

15. F. lamourouxii, Br.
16. F. spathulatus, n. sp.
17. F. bertrandi, n. sp.
18. F. gazolanus, Br.

VII. Dictyotites.*

19. F. flabellaris, Br.
20. F. multifidus, n. sp.
21. F. digitatus, n. sp.

VIII. Amansites.

22. F. dentatus, n. sp.
23. F. serra, n. sp.

IX. Caulerpites.

24. F. lycopodioides, n. sp.
25. F. selaginioides, n. sp.

25.*bis* F. hypnoides, n. sp.

26. F. frumentarius (Schloth.), sp.

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*In the Proceedings of the U. S. National Museum (Vol. xvi, 1893, p. 113), Dr. D. P. Penhallow has applied this name to a *new genus* of fossil plants. On page 109 he mentions its use by Brongniart in 1828, but, considering that the name "has lost its function," he uses it again. Such a proceeding is not in accordance with the generally adopted rule of nomenclature, that a name once used can not be used again, if applied to a new organism. We do not believe Dr. Penhallow's action will be generally concurred in.

27. F. nilsonianus, n. sp.—*Caulerpa septentrionalis* Ag., and *F. imbricatus* Stern.

28. F. brardii, n. sp.—*Carpolithes hemlocinus* (?) Schloth.

29. F. orbignianus, Br.

X. Species that do not appear to belong to any of the preceding.

30. F. agardhianus, Br.

*Doubtful species.

31. F. pectinatus, n. sp.—*Carpolithes* (?) and *Algacites orobiformis* Schloth.

32. F. turbinatus, Br.

33. F. discophorus, Br.

34. F. lyngbianus, n. sp.

35. F. (?) cylindricus, Stern.

36. F. circinatus, n. sp.

It will be observed from this list that the type of the genus, *F. strictus*, is placed under the second section, FUCITES, by itself. In putting it here Brongniart says that it resembles in its general form *Fucus obtusatus*, but differs essentially in a large and thick nerve that traverses the frond; furthermore, that it is really more like a solid axis than a real nerve. There are various other differences. A comparison is also made with a species of *Rhodomela*, but it is finally stated that the fossil differs from all living species known to the author. (p. 53.)

This fossil is, in all probability, the remains of a plant;* and in view of this fact, and because the genus contains species that have been referred to various genera, it seems best to return to the original name, restrict the genus to the one species and call it FUCOIDES STRICTUS Brongniart. (Pl. III, Fig. 2.)

Of the remainder of the species, there are but six which call for any special attention here. They are:

F. targonii.	F. furcatus.
difformis.	antiquus.
recurvus.	circinatus.

*This plant seems to be the same as Goeppert's species *Haliserites dechenianus*. Certainly the figures correspond almost exactly, and specimens of Goeppert's species would very readily pass for Brongniart's *Fucoides strictus*. It seems, therefore, best to the author to reduce Goeppert's name to a synonym of *F. strictus*. Should this be done, it will necessitate a change in certain new varieties and species made by Penhallow in the paper cited above.

Of these six, five were placed by Brongniart in his subgenus GIGARTINITES. They have been generally referred to the genus *Chondrites*, of Sternberg. There is every reason for believing that this genus, like *Fucoides*, contains a number of diverse forms, and will have to be finally broken up. Undoubtedly a great number of the species are remains of plants, but those in the list above given are doubtless worm burrows. They are, at all events, very problematic organisms, and we propose that the genus *Gigartinites*, Brongniart's section, be established for the first five species. The species *targionii*, as the first one described by Brongniart under his section, should be taken as the type. They would then stand as follows:

Gigartinites targionii, (Br.)	Gigartinites furcatus, (Br.)
difformis, (Br.)	antiquus, (Br.)
recurvus, (Br.)	

The figures which are given illustrate these species. They are taken from Brongniart's Histoire des Végétaux Fossiles, Vol. 1. (Pl. III, Fig. 1; Pl. IV, Pl. V.)

The last species of the list is *F. circinatus*, and of this we also give a figure (Pl. III, Fig. 3). It differs in many ways from the others, and of it Brongniart says: "This *Fucus* attained nearly a foot in height; it is in general enclosed in the freestone perpendicularly to and not parallel with the beds, like the most of the plants transported and deposited in the place where the rock enclosing them was formed." (p. 84.) From this statement it seems evident that the fossil was not a plant, and in all probability it represents the remains of a worm burrow. It presents a great analogy to several species described by Billings as *Licrophycus*. It will be referred to at another time in more detail.

In 1831 Germar and Kaulfuss* described and illustrated *Fucoides acutus*. This is, in all probability, a plant, and is now known under the name of *Aphlebia acuta* (G. & K.,) Presl. In the same year (1831) Richard Harlan described† and illustrated *Fucoides alleghaniensis* as a new species occurring in one of the ridges of the Alleghany Mountains. This species is now generally known as *Arthrophycus harlani*, but its

*Acta Acad. Cæs.-Leop. Carol. Nat. Cur., vol. xv, pt. 2, p. 230.

†Jour. Acad. Nat. Sci. Phil., vol. vi, pp. 289-291, pl. 1.

proper designation should be *A. alleghaniensis.** In January, 1832, the same writer† described a second species under the name of *F. brongniartii* from a sandstone beneath the "coal formation," occurring in the western part of New York. This is the same species as that described by him previously. In 1833, Mantell‡ described *Fucoides brongniartii*, not knowing of the previous use of the name. This is a very different species from that described by Harlan, and seems to be part of the frond of a fern. Its specific designation will probably not have to be changed, as it does not belong to the genus *Fucoides*. In 1835, Aug. von Gutbier‖ described the following species, most of which are of real vegetable origin:

F. filiciformis.	F. crispus.
radians.	crenatus.
filiformis.	dentatus.
linearis.	

Of these *F. crenatus* is a problematical form; *F. dentatus*§ is now *Rhacophyllum flabellatum*. In 1835, Hitchcock¶ described *Fucoides shepardi* as a sea-weed which penetrated the rocks perpendicularly. This is now known as *Scolithus shepardi.*** In 1837, Messrs. Lindley and Hutton described and illustrated *Fucoides arcuatus*.†† This is doubtless a worm burrow, similar in aspect to *F. antiquus*, and may be the same. In the same year, Hisinger‡‡ described a variety of *F. antiquus* under the name of var. *gracilior*. This is also a problematic organism and scarcely differs from *F. antiquus*.

In 1838 appeared the second volume of Sternberg's work,‖‖ the first volume of which had been printed in 1825. Here we find Brongniart's genus broken up into various genera,

*This subject has been thoroughly investigated by the author, and the details are given in another paper, not yet published. It was, however, read before the American Association for the Advancement of Science, at Madison, in August, 1893.

†Harlan, R. Monthly Am. Jour. Geol. and Nat. Sci., vol. i, pp. 307-308.

‡Geology of the Southeast of England. London, 1833, pp. 95-96.

‖Abdrucke und versteinerungun des zwickauer Schwarzkohlengebirges und seiner umbebungen. Zwickau, pp. 36, pl. 11.

§Brongniart had used this name in 1828.

¶Rept. on Geol. Min. Bot, and Zool. of Mass., 2d ed., p. 236.

**James, J. F. Bull. Geol. Soc. Am., vol. iii, 1891, p. 32.

††Fossil Flora of Great Britain, vol. iii, p. 93, pl. 185.

‡‡Lethaea svecica. Holmiae, 1837, p. 106. Supple., 1840, p. 2.

‖‖Versuch einer geognostisch-botanischen darstellung der flora der vorwelt. Prag, 1838. Folio.

the most of them being equivalent to his sections. All are arranged under Algæ, and a number of new genera are proposed. For example, we find that *Rhodomelites* is proposed for *Fucoides strictus*. *Chondrites* is proposed for the group *Gigartinites* of Brongniart. *Sphærococcites*, *Halymenites*, *Munsteria*, *Haliserites*, *Zonarites*, *Cystoseirites*, are among the new names. *Fucoides taxiformis* Sternb., 1825, is referred to *Cystoseirites*; and *Fucoides dichotomus* Reich (in litt), is referred to *Haliserites*. The species referred to *Chondrites* are as follows:

C. targionii, Br.	C. antiquus, Br.
difformis, Br.	circinnatus (!), Br.
æqualis, Br.	laxus, Sternb.
intricatus, Br.	obtusus, Br.
recurvus, Br.	turbinatus, Br.
furcatus, Br.	discophorus, Br.

Of these, the 1st, 2d, 5th, 6th and 7th, we have referred above to the genus *Gigartinites*. The others are for the present left in *Chondrites*, although it is not improbable that they will be subsequently referred to other genera. Some of them are of undoubted algal origin. In the same year (1838) Conrad* changed Harlan's *Fucoides alleghaniensis* to *F. harlani*, and at the same time mentioned several other species of *Fucoides*, but without descriptions. Among them was *F. demissus*, which was subsequently described by Hall as *Phytopsis tubulosa*, and is now generally recognized as a coral. In the same report (p. 111) *Fucoides cauda-galli* was named. This species was afterward referred to *Spirophyton* by Hall, but it should probably be placed in the genus *Taonurus*. This question we hope to discuss another time. In 1840, S. S. Haldemann† published a description of a fossil referred by him with a query to the genus *Fucoides*, coining for it, however, in the next paragraph, the new genus *Scolithus*. This is evidently a worm burrow, and ever since its description has been considered the type of *Scolithus*. It need not be further considered.

*2d Ann. Rept. Geol. Sur. N. Y., 1838, p. 113.

†Supplement to No. 1 of "A Monograph of the Limniades or Fresh Water Shells of North America."

In 1842, Vanuxem[*] figured *Fucoides biloba* from the Clinton. This is now called *Cruziana bilobata*. In the same volume he described the "Cock-tail" Grit as characterized by several peculiar forms of "fucoids," calling them "curtain" and "retort" fucoids. These species are now placed in the genus *Spirophyton* or *Taonurus*. *Fucoides graphica*, a very problematic organism, is also described. Of it Vanuxem says, that "as yet the real nature of these bodies is doubtful, and they are, therefore, classed as fucoids." (p. 173.)

Several species of the genus were described by Hall in 1843.[†] Of these *F. auriformis* (p. 47), and *F. heterophyllus* (p. 47), from the Medina, are of inorganic origin, and should be expunged from lists of fossils. *Fucoides gracilis*, later on referred to the genus *Buthotrephis*, was described on page 69. It is probably referable to *Chondrites*. *Fucoides verticalis* (p. 242) is a worm burrow, and is now referred to the genus *Scolithus*. In 1844, Emmons[‡] described as new *Fucoides flexuosa* and *F. rigida*. Both of these are worm burrows, probably forms of the same. He also figured on plate five *F. simplex*, which is now recognized as a graptolite. The following year (1845) Pomel[||] described two species under the names of *Fucoides beaumontianus* and *dufrenoyi*, both of which are, as far as descriptions indicate, of vegetable origin. I do not know in what genus they are now placed. In 1847, Prof. James Hall[§] referred *F. rigida* and *F. flexuosa* to a new genus with a query, under the name of *Buthotrephis flexuosa*, considering the former species a synonym (p. 263); while in the following year (1848) McCoy[¶] referred both the above species of Emmons and *F. antiquus* Brong., from Norway, to *Chondrites*. In 1851, Prof. James Hall[**] figured and mentioned *Fucoides duplex* from the Potsdam. As there is no description, it is necessary to study the figure, and this would indicate an approach to some species of *Cruziana*. It may be this species that is called by Chamberlin[††] *Palæophycus duplex*. In

[*] Geol. Sur. of New York, Rept. of the 3d Geol. Dist., 1842, p. 79.
[†] Geol. Sur. of New York, Rept. of the 4th Geol. Dist., 1843.
[‡] The Taconic System, 1844.
[||] Bull. Geol. Soc. France, 2d ser., t. ii, 1845, pp. 310–311.
[§] Pal. of New York, vol. i, 1847.
[¶] Quart. Jour. Geol Soc. London, vol. iv, 1848, p. 224.
[**] Foster and Whitney Lake Superior Land District Rept., part 2, p. 226, pl. 23A.
[††] Geol. of Wisconsin, vol. 1, 1883, p. 126.

1852, Goeppert* described, under the name of *Haliserites deschenianus*, a fossil which presents every appearance of being the same as Brongniart's *Fucoides strictus*.† In 1874, Schimper‡ placed *Fucoides antiquus* as the type of the genus, but it is difficult to understand how this can be so when this species was not described until 1828, long after many other forms had been described. This same refeience is made by Roemer in 1880.||

In 1865, Oswald Heer§ mentioned the occurrence of three species of *Fucoides* under the names of *rigidus*, *procerus* and *moeschii*. The last is the only one figured, and it is a very problematical form, having something the shape of Billings's genus *Arthraria*. It certainly is not congeneric with *Fucoides strictus*. Finally, the last species we have found referred to the genus is *Fucoides rouaulti* Lebsc. This was described in 1883,¶ but mentioned again in 1886.**

In the preceding pages it has been the endeavor of the author to present an accurate statement of the genus *Fucoides*, and to give accurate bibliographic items regarding the species referred to the genus at various times. Many points have been left untouched which might have been elaborated; and it is hoped that the few suggestions made may be acceptable to the readers of the paper. In the course of the preparation of this and the paper upon *Scolithus*, a large amount of material has been collected. It is the hope of the author to present some of this to the public upon some future occasion. He would feel greatly obliged if his readers would call his attention to errors in the list of species given below.

The following list gives the names of species that have been described as *Fucoides*, with the authority and date and the name which is recognized at the present time. It is very probable that further study will materially change many of the latter names. Some have been referred to many genera

*Novo. Acto. Acad. Caesar. Leopol.—Carol., vol. xxii, supple., p. 185.

†See note on a previous page.

‡Traite de Palæontologie Vegetale, vol. i, p. 442.

||Lethæa Palæozoica Text Erste Lief., vol. i, p. 132.

§Die Urwelt der Schweiz, pp. 70, 100.

¶Œuvres posthemes de Rouault, 1883.

**Bull. Geol. Soc. France. 3d ser., t. 14, 1886, p. 794.

and have experienced many changes. It will only be possible to state accurately the proper name after an investigation of the genera. If the principle of nomenclature, which makes it necessary to use the first specific name be followed, there will be many changes in this respect. The list, therefore, as far as the second column goes, is provisional merely. It is believed that the first column is very nearly complete. As already stated, we have restricted the name *Fucoides* to the single species *strictus* Br., 1822. The genus *Gigartinites* is here used as a generic term for the first time, Brongniart using it only in a sub-generic sense:

Fucoides acutus, Germ. et Kaulf., 1831.	Aphlebia acuta.
æqualis, Br., 1823.	Chondrites æqualis.
agardhianus, Br., 1823.	Delesserites agardhianus.
alleghaniensis, Harlan, 1831.	Arthrophycus alleghaniensis.
antiquus, Br., 1828.	Gigartinites antiquus.
var. gracilior, His., 1837.	antiquus.
arcuatus, Lind., & Hut., 1837.	Sphærococcites arcuatus.
auriformis, Hall, 1843.	Inorganic.
beaumontianus, Pomel, 1845.	?
bertrandi, Br., 1828.	Delesserites bertrandi.
biloba, Vanuxem, 1842.	Cruziana bilobata.
bohemicus, Sternb., 1825.	Sargassites sternbergii.
bollensis, Zilt, 1827.	Chondrites bollensis.
brardii, Br., 1828.	Caulerpites brardi.
var., Br., 1828.	Cupressites ullmanni.
brianteus, Villa.	Zoophycos villæ.
brongniartii, Harlan, 1832.	Arthrophycus alleghaniensis.
brongniartii, Mantell, 1833.	?
cauda-galli, Conrad, 1838.	Taonurus cauda-galli.
circinatus, Br., 1828.	Licrophycus circinatus. ?
crenatus, Gutb., 1835.	Aphlebia crenatus.
crispiformis, Br., 1823.	Sphærococcites crispiformis.
crispus, Gutb., 1835.	Aphlebia crispa.
cylindricus, Sternb., 1825.	Halymenites cylindricus.
demissus, Conrad, 1838.	Phytopsis tubulosa.
dentatus, Br., 1828.	Diplograptus pristiniformis.
dentatus, Gutb., 1835.	Rhacophyllum flabellatum.
dichotomus, Reich, in litt. 1838.	Haliserites reichii.
difformis, Br., 1823.	Gigartinites difformis.
digitatus, Br., 1828.	Zonarites digitatus.
discophorus, Br., 1823.	Tympanophora discophora.
dufrenoyi, Pomel, 1845.	?
duplex, Hall, 1851.	Cruziana duplex. ?.

Fucoides elegans, Br., 1823.	Podocarpus sp.
encoelioides, Br., 1828.	Munsteri clavata.
filiciformis, Gutb., 1835.	Rhacophyllum filiciforme.
filiformis, Gutb., 1835.	filiforme.
filiformis, Steing.	?
flabellaris, Br., 1823.	Zonarites flabellaris.
flexuosa, Emmons, 1844.	Chondrites flexuosa.
frumentarius (Sch.), Br., 1828.	Caulerpites frumentarius.
furcatus, Br., 1823.	Gigartinites furcatus.
var. ? Br., 1828.	Halymenites ramulosus.
gazolanus, Br., 1823.	Delesserites gazolanus.
gracilis, Hall, 1843.	Chondrites gracilis.
granulatus (Schl.), Sternb., 1825.	Phymatoderma liasicum.
graphica, Vanuxem, 1842.	?
harlani, Conrad, 1838.	Arthrophycus alleghaniensis.
hechingensis, Quenst.	Chondrites hechingensis.
heterophyllus, Hall, 1843.	Inorganic.
hypnoides, Br., 1828.	Caulerpites hypnoides.
imbricatus (Sternb.), Br., 1828.	Caulerpites nilsonianus.
intricatus, Br., 1823.	Chondrites intricatus.
lamourouxii, Br., 1823.	Delesserites lamourouxii.
linearis, Gutb., 1835.	Aphlebia linearis.
? linearis, Hald., 1840.	Scolithus linearis.
lycopodioides, Br., 1828.	Caulerpites lycopodioides.
lyngbianus, Br., 1828.	Sargassites lyngbianus.
moeschii, Heer, 1865	?
multifidus, Br., 1828.	Zonarites multifidus.
nilsonianus, Br., 1828.	Caulerpites nilsonianus.
obtusus, Br., 1823.	Chondrites obtusus.
orbignianus, Br., 1823.	Caulerpites orbignianus.
pectinatus, Br., 1828.	Caulerpites pectinatus.
pennatulus, Br., 1823.	Pterophyllum preslanum.
procerus, Heer, 1865.	?
radians, Gutb., 1835.	Rhacophyllum adnascens.
recurvus, Br., 1823.	Gigartinites recurvus.
retortus, Vanuxem, 1842.	Taonurus retortus.
rigidus, Emmons, 1844.	Chondrites flexuosa.
rigidus, Heer, 1865.	?
rouaultii, Lebsc., 1883.	?
selaginoides, Br., 1828.	Caulerpites selaginoides.
serra, Br., 1828.	Graptolithus bryonoides.
secalinus, Eaton, 1832. ? Mss.	Diplograptus secalinus.
septentrionalis, Br., 1828.	Sargassites septentrionalis.
shepardi, Hitch., 1835.	Scolithus shepardi.
simplex, Emmons, 1844.	Diplograptus secalinus.
spathulatus, Br., 1828.	Delesserites spathulatus.

Fucoides sternbergi, Br., 1828.	Sargassites sternbergi.
stockii, Br., 1828.	Halymenites stockii.
strictus, Br., 1822.	Fucoides strictus.
targionii, Br., 1828.	Gigartinites targionii.
taxiformis, Sternb., 1825.	Cystoseirites taxiformis.
tuberculatus, Br., 1828.	Laminarites tuberculosus.
turbinatus, Br., 1823.	Tympanophora turbinata.
velum, Vanuxem, 1842.	Taonurus velum.
verticalis, Hall, 1843.	Scolithus verticalis.

REMARKS ON THE GENUS ARTHROPHYCUS, HALL.

By Joseph F. James, M. Sc., F. G. S. A., etc.

In studying the literature of what are designated as "Problematic Organisms," several facts relative to nomenclature have come to the attention of the writer, which seem worthy of record. The one which will be referred to on the present occasion, is the relation between *Arthrophycus harlani* and *Harlania halli*, both unquestionably applied to the same fossil form. The position of the fossil in the zoological or botanical scale will not be discussed here. It will be sufficient to say that originally described as an alga, it has been generally placed in the vegetable kingdom. Various authors have, however, contended that it is not a plant, but represents the track of some animal form.

The first description of the fossil, although not accompanied by any name, is accurate enough to enable one to recognize it. It appears in the second edition of Amos Eaton's "Index to the Geology of North America," (pp. 211–212), published in 1820. In describing the red sandstone of the Niagara River, now recognized as the Medina, he refers to some fossils that had been considered to be the remains of plants; "but," says he, "on tracing several specimens to their natural terminations, they appear to end like the terete posterior extremity of the common earth-worm, or angling worm. * * * After a very attentive review of thousands of these petrefactions, I am convinced that their prototype was not any species of plant with which I am acquainted; and I am inclined to refer them to the tribe of naked vermes, notwithstanding they present arborescent, plant-like appearances. I say naked, because there is not a particle of carbonate of lime embraced in them. But they are perfect substitutions of

sandstone, though much finer grained than the enclosing rock. They are from one inch in diameter to the size of a small goose quill. I have traced some of them ten or twelve feet in a serpentine course, without finding a natural termination, and sometimes without discovering much difference in the diameter. Their texture sometimes appears a little fibrous, and often presents the appearance of concentric layers. Though their natural form is terete, they are often much compressed.

"They are not confined to the plane of the layers of the enclosing rock, but often penetrate it obliquely. Several branches originate from a thick stock in some specimens like roots from the bottom of a stump."

In 1831, Richard Harlan described and illustrated* the same fossil under the name of *Fucoides alleghaniensis.* The specimens came from one of the ridges of the Alleghany Mountains, in Pennsylvania. They were very numerous, and varied in size from two to five inches long, the largest being $\frac{8}{10}$ inches thick. In the following year the same author† described, from a sandstone in the western part of New York, a second species under the name of *Fucoides brongniartii.* This is evidently the same form as that first described, but it should not be confounded with *F. brongniartii*, of Mantell, described from England, in 1833.‡ This is without doubt a vegetable organism, the present generic designation of which I am unable to give.

In 1834, R. C. Taylor|| reprinted Harlan's description of *Fucoides alleghaniensis*, and discussed the graywacke group of North America. He mentions the occurrence of the species at various points in the Alleghany Mountains and gives a figure of it. Several beds of rock contain the "plant;" no casts of shells, "nor, indeed, any other organic body, occur with these deposits."

*Description of an extinct species of fossil vegetable, of the family Fucoides. Jour. Acad. Nat Sci., Phila., vol. vi, 1831, pp. 289–295.

†On a new extinct fossil vegetable of the family Fucoides. Monthly Am. Jour. Geol. & Nat. Sci., vol. i, Jan., 1832, pp. 307–308.

‡The Geology of the Southeast of England. London, 1833, pp. 95–96.

||A description of a fossil vegetable of the family Fucoides, in the Transition Rocks of North America, and some considerations of geology connected with it. Loudon's Mag. Nat. Hist., vol. vii, 1834. pp 27–32.

In 1835, Taylor published a second article,* in which he described in detail the beds in which the fucoids occur. That near Lewistown is especially noticed. The thickness of the beds is estimated at 200 feet. He infers the existence of numerous surfaces upon which vegetation grew, and believed the rocks were formed in quiet water. No animal remains had been discovered in them. A figure is given of *F. brongniartii*, together with that of an unnamed species. In 1836, Harlan published† a long article, during the course of which he referred to the two species of *Fucoides* described by him, and pointed out the differences between them and Mantell's species. He also noticed some remarks make by Hitchcock,‡ in which a very different form was compared to *F. brongniartii*. In 1837, Conrad,|| in discussing the "Organic remains of the Red Sandstone," refers to the presence of various fucoids, and on page 168 records the presence of *Fucoides brongniartii* Harlan, and on page 171 *F. alleghaniensis*. Both occur in the red sandstone of Niagara Falls. In 1838, Conrad, in speaking of the fucoids of the 3d Group of New York, says:§ "The organic remains consist chiefly of *Fucoides harlani* nobis (*F. brongniartii* Harlan)." The mention here of *Fucoides harlani* is the first instance of the use of that specific name. The reason for the adoption of this new name does not appear. It has ever since been known in literature as *harlani*.

In the following year (1839) the same writer,¶ in discussing the fucoids of New York, said, that while some naturalists had paid very little regard to them, particular species were "more absolutely limited to the respective rocks in which they originated" than were the testacea. He referred then to *Fucoides harlani*, as being "extremely abundant in the red

*On the geological position of certain beds which contain numerous fossil marine plants of the Family Fucoides, discovered near Lewistown, Mifflin County, Pennsylvania. Trans. Geol. Soc. Penn. vol i, 1835, pp. 5-15.

†Critical notices of various organic remains hitherto discovered in North America. Trans. Geol. Soc. Penn., vol. i, 1835, pp. 46-112.

‡Report on the Geology, Botany and Zoology of Massachusetts. Amherst, Mass., 1833, p. 233.

||1st Annual Report of the Geological survey of the 3d District of New York. 1st Ann. Rept. Geol. Sur. N. Y., 1837, p. 167.

§Report of T. A. Conrad on the Palæontological Department of the Survey. 2d Ann. Rept. Geol. Sur. N. Y., 1838, p. 113.

¶Conrad, T. A. Second Annual Report of the Palæontological Department of the Survey. 3d Ann. Rept. Geol. Sur. N. Y., 1839, pp. 60-61.

shales of Medina and Rochester, and in the equivalent sandstones and shales of Pennsylvania and Virginia, and is more generally known than any other species. It is absolutely limited to this particular formation, serving to identify it in every locality."

There are various other references to the species in the reports of the New York survey, but they need not be mentioned here. The generic name, *Arthrophycus*, was given by Hall in 1852.* Under the specific name, *harlani*, there are given as synonyms *Fucoides alleghaniensis*, *F. brongniartii* Harlan, and *F. harlani* Conrad. In this same year, 1852, H. R. Goeppert† established a genus under the name of *Harlania*, giving as the specific name, *halli*, and as synonyms *Fucoides harlani* Conrad, and *F. brongniartii*, and *F. alleghaniensis* Harlan.

The coincidence in date of publication of these two genera has led to considerable diversity of opinion as to which one should be used. Both volumes are dated 1852 on the title page. In the introductory remarks to the Palæontology of New York, Prof. Hall says that the printing of the volume was in progress in February, 1849, and about 120 pages were printed before the work was stopped. "Except the last fifteen pages," he says, "the printing of this volume was completed in the early part of 1850; but the engraving had not been finished to permit its appearance till 1852." As the description of the genus appears on page four, and the fossil is figured on Plate I, we seem justified in assuming the genus was really in print before 1850, although the volume was not published until 1852. That the volume was regarded as printed in 1851 by Prof. Hall, is evidenced by the fact that several references are made to it in part two of Foster and Whitney's Report on the Lake Superior Land District,‡ the date of publication of which is December, 1851. On the other hand, there is no reason for supposing that Goeppert's paper appeared before 1852, or that any part of it was in print

*Pal. of New York, vol. ii, 1852, p. 4.

†Fossile flora des Ubegangsgebirges. Novo. Acto. Acad. Caesar. Leopol.—Carol., Suppl. vol. xxii, Breslau & Bonn, 1852.

‡See pages 207, 219, 222, 223.

before that time. Roemer* states that Volume II of the Palæontology did not appear until 1853, and upon this ground he gives *Harlania* the preference. He has been followed in this by various authors, but, in our opinion, he is not justified in so doing. We shall, therefore, consider *Arthrophycus* as the proper generic designation.

There is also a question as to the specific name. If priority has aught to do with the matter, as it certainly should have, Harlan's name, *alleghaniensis*, is the proper designation. It was proposed and defined seven years previous to Conrad's substitution of the name *harlani*, and twenty-one years before Goeppert's *halli*. The name given by Harlan was not preoccupied in the genus *Fucoides*, and it was well defined and illustrated. There seems absolutely no reason for the change made by Conrad. It appears proper, therefore, to the writer that the fossil form in question should bear the name ARTHROPHYCUS ALLEGHANIENSIS (Harlan), Hall.

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*Roemer, Ferd. Lethæa palæozoica. Lief. 1, Stuttgart, 1880, p. 135. It is rather to ungracious task to criticise, but attention should be called to several serious errors in dates in this publication. For example, 1824 is given as the date for DeKay's genus, *Bilobites*. It should be 1823. *Rusophycus* Hall, is given as 1825. It should be 1852. *Fucoides cauda-galli* is given as Vanuxem, 1842. The name was used by Conrad in 1838. Finally, under *Harlania*, we find in the synonomy "*Fucoides brongniartii* Harlan, Phys. and Medic. Researches, 1827." It should be Jour. Acad. Nat. Sci., Phila., 1831. *Fucoides alleghaniensis* should be 1831 instead of 1838. *Fucoides harlani*, given as 1843, should be, as above pointed out, 1838. With all these errors, we need not be surprised if there was a mistake in the date given for the publication of volume two of the Palæontology of New York.

NATURAL HISTORY NOTES FROM NORTH CAROLINA.

By A. G. Wetherby.

On the 28th day of April, 1886, the writer left Cincinnati, and took up his residence at "Roandale Farm," Mitchell County, North Carolina. The farm is located on what is known as Big Rock Creek, a rapid mountain stream, which drains the western slope of the great Roan, the monarch of the Appalachians, and which lies in profile to the east for several miles, as well as the eastern slope of the Unakas. The plateau, from which these elevations rise, is bounded on the north by Iron Mountain, which unites the north-western slope of the Roan with Big Bald Mouutain of the Unakas, making a horseshoe-shaped curve in the course of the connection. Thus, we live in a basin, having the Roan on the east, Iron Mountain on the north and north-west, and the Unakas on the west. The Roan reaches an elevation of 6,400 feet, Iron Mountain of from 3,500 to 4,500 feet, and the Unakas of from 4,000 to 5,500 feet. The plateau at Roandale Farm has an average elevation of about 3,000 feet, and slopes to the south, where the drainage is poured into Toe River.

To the geology, botany and general zoology of this highly interesting region, I have given much of my spare time during the last seven years, and I now propose to set out in this paper a few of the results, which, I trust, may not be uninteresting to the readers of this Journal.

As might be expected from the elevation, our climate is that of several degrees north, being at least as cool as the average climate of Cincinnati, although our cold weather in Winter is not so continuous, and in Summer the nights are always cool.

Indeed, no Summer climate can excel this for perfection of rest and comfort. Grass, flowers and cultivated vegetables

remain thrifty and fresh all Summer. Noxious insects are absolutely unknown, and the water is perfect. No region can excel this in either wild or cultivated fruits. We are, however, in the very heart of the Appalachians, twenty-five miles from a town of any size, the same distance from any good market, ten miles from one railroad and fifteen from another. If here are rest and quiet personified, so here is isolation enthroned.

GEOLOGICAL FEATURES.

The geology of this region is not well understood. In several reports, made by the geologists of the State and by the General Government, the formations have been lumped together as Laurentian and Huronian, but no thoroughly detailed studies have been made. The rocks are granites and syenitic granites, gneisses and gneissoid schists, talcose and chloritic schists, with many intersections by at least two series of dikes, some of these of enormous extent. The granitic and syenitic rocks often carry a predominance of quartz, and form sharp ridges. The gneisses and schists generally weather off into rounded summits, with more gentle and fertile slopes. Passing across the country, from south-east to north-west, we should have a cross section of the region showing its general geological structure. The Roan is made up of rocks which have been called Laurentian, and they are much disturbed and intersected by dikes of greenstone. They dip to the south-east at a high angle, and the whole mountain is monoclinal in structure. Passing on across the plateau above described, until we reach the foot of the eastern slope of the Unakas, we come to an aggregation of talcose and chloritic schists, gneisses and strata and seams of quartz, which series has been referred to the Huronian.

This group continues to occupy our section until we come to the foot of Iron Mountain, on the north-west, where it abuts, abruptly, and without any transition series, upon a heavy bedded quartzyte, referred by the geologists who have studied it, to the Potsdam. I intend in a future article to furnish detailed sections, and to attempt to elucidate some points in regard to the nomenclature of these rocks, which, I

think, needs revision. This whole region is a primitive forest, except for the small and scattered mountain farms and the cleared lands of the valley, and every foot of it teems with features of interest to the geologist, botanist, ornithologist and student of natural history generally. There are many evidences, conclusive to my mind, of local glaciation. It may be that this suggestion will be read with a smile by other geological students of this region; but they should carefully examine my evidences before arriving at conclusions. This region has proven to be as rich in archæological treasures as in those of nature herself, and we have made here a collection of implements, embracing several thousand specimens, a large number of which are undoubtedly palaeoltithic. This statement, like the previous one, may seem to be so bold as to destroy the merit of its originality, but we have the testimony in the implements themselves. It is a fact well known to the students of American malacology, that this region has, within the last few years, furnished a very large number of new forms of land shells, which have been erected into species by the book-makers. To this series we have recently contributed three others, one of which has been described by Pilsbry in the *Nautilus* for May, 1893, as *Triodopsis subpalliata*, and two of which, *Zonites*, will be published later. We have given some attention to the entomology of this locality, and find it of surpassing interest. The specimens collected have, however, mostly been sent to Mr. Charles Dury, the eminent entomologist of the Cincinnati Society of Natural History, and whatever may be of special interest concerning them is left in his hands.

We have recently been making some collections of the mammals of this region, and have found them very interesting, not only from the standpoint of geographical distribution, but because of the species themselves. We became interested in them as the result of a visit to Dr. C. Hart Merriam, Chief of the Bureau of Ornithology and Mammalogy of the Department of Agriculture. This eminent student of the North American Mammalia has the rare faculty of interesting all who come in contact with him, by virtue of his industry, his enthusiasm, his kind and gentle manner, and more especially by his profound knowledge of the subject.

In him the Government certainly has an energetic, critical and thoroughly-informed specialist, whose only object is to reach facts. Acting upon Dr. Merriam's suggestion, we have succeeded in capturing the list of mammals which will be enumerated further along, and have made the accompanying notes as to their habits, etc. To the ornithology of the country about us we have given considerable study, and such notes as we have made will be contributed if any future paper is written. I now propose to take up these subjects, seriatim, and will begin with the land mollusks, for the reason that I have studied them more closely than any other of our varied fauna.

And here it seems to me to be eminently fitting that something should be written in relation to the present mania for species-making. All careful students of our North American shells know, whether the series examined be land, fresh water or marine, that we have an infinite number of varietal forms, connecting links, as it were, serving to show the processes and progress of variation. In the case of the Unionidæ, there are certain forms, which may be taken as the types of series, so united by the closest relationship of external characters, that in many instances half a score or more of described "species" must fall into synonomy. These are not isolated cases, but they are the rule. Should these forms be treated as a philosophical handling of the subject demands, the so-called "species" would be reduced more than one-half! This is a fact, about which there is no question in the mind of any student of these sheils, who seeks truth, and not the mere adding of species to his collection. There is no need of any more species in cabinets than exist in nature. A shell labeled with a specific name, under a definition that cuts off both ends of its relationship, is nothing but an isolation. A shell so labeled and arranged as to exhibit its relationship to the other forms with which it is grouped, is a very different thing; it is a land-mark, a part of a system, a guide, a revelation. Why, then, should the profound uses of such forms be wrapped up in the mantle of specific designation, on the vain supposition that publishing and describing these forms under titles of limitation will add anything to science or to the reputation of the writer? The thing most necessary now in

the study of zoology is to eradicate. That is the way to systematize. The "systematic zoologists" should understand that the way to systematize is to weed out. What vain labor is it to waste time in the definition of "new species," when there is no agreement possible as to what the limit of specific rank is. Each puts his own interpretation upon the record of nature. As no agreement has been reached, and none ever will be reached, why not leave this matter to adjust itself in the orderly and comprehensive manner dictated and designed by the life principle itself?

With hundreds of synonyms already burdening the malaco logical literature of our land, the blind men still dabble in the small pool at their feet, all unmindful of the vast expanse beyond them. Worse than all, a number of foreign writers, who know next to nothing of the subject, if we are to judge their learning by their crude utterances, are filling in their "new species" and "varieties," followed complacently by the writer's name, as though any American student of our shells did not recognize that it is all twaddle, and a part of that profound conchological investigation which originated mathematical formulæ for the number of stripes on a *Helix nemoralis!*

The proper treatment of this subject is that of Mr. Chas. T. Simpson, whose late contribution (Notes on the Unionidæ of Florida and the South-Eastern States, Proceedings U. S. National Museum, Vol. XV.) is by far the most careful, philosophical and useful paper ever published relating to these protean bivalves. Basing his paper upon a private collection of over seven hundred species, with great experience as a field naturalist, with all the recent types of new species at his command, and with the unequaled collection of the National Museum before him, this gentleman has given us a treatise that should be carefully studied by all students of our mollusks, and might, with great profit and advantage, be studied by all the systematic zoologists of the world. The time is coming when describing fragments of fossils as species, and piling up endless generic definitions on casts and molds of extinct animals, will cease to be regarded as in any way a useful contribution to science. As the earth's races have gone forward in development, or have passed off the stage,

the victims of the inevitable fiat of progress, or have yielded to the changing environments of the ages, their record is the same as that of those in existence. The fore front of modern investigation should march in this line, and those who prefer to belittle the whole manner of the past and present working of this grand harmony of natural law, should be left to play at scientific study with those who prefer such methods. The true naturalist can not afford it.

NOTES ON THE LAND SHELLS OF ROAN MOUNTAIN AND VICINITY.

1. *Mesodon albolabris*, Say. This species occurs here, with the others of this group. It has its typical form, but there occur varieties uniting it with the following.

2. *Mesodon major*, Binney. I long considered this form to be a distinct species. The late Thos. Bland, the highest American authority on our land shells, regarded it as a variety of the above. There are forms of a nature to puzzle the naturalist, uniting this and the following.

3. *Mesodon andrewsi*, W. G. Binney. This form occurs at all elevations, from the plateau to the summit of Roan, and exhibits, as might be inferred, very great varietal differences. Individuals from the foot of the mountain are larger, heavier and more uniform in color, the shells being of a greenish white. Those from the top are thinner, smaller and often very dark smoke color — very beautiful shells.

4. *Mesodon exoletus*, Binney. This species occurs somewhat sparingly, some of the forms being typical and others without the parietal tooth. Having collected and carefully prepared several hundred specimens of the four species above enumerated, I am prepared to say and to show, that while types of each species as described may be selected, it is not difficult to so arrange the whole series, by intergrading varieties, as to leave the question of specific distinctness in doubt, so far as the shells are concerned. The comparative anatomist might find slight differences in the animals, but this is what should be expected. There is no collection of individuals of any species that does not carry with it forms stamped with the law of variation, which is as persistent and as self-asserting

as is life itself. This subject may be discussed in detail hereafter should the occasion demand.

5. *Mesodon thyroides*, Say. This species is rare here. The specimens are in every way normal, so far as I have collected them.

6. *Mesodon wheatleyi*, Bland. This rare shell has the same distribution as number three. In the lower part of its range, the shell is larger and heavier, but as we approach the summits of the mountains it becomes thinner and lighter, as well as smaller. It seems to prefer hiding away in crevices of the rocks, and it is hard to find except during rainy weather.

7. *Mesodon profundus*, Say. This species occurs here in fair numbers, presenting the same varieties that are familiar to Cincinnati collectors, but of rather smaller size than the Ohio and western shells.

8. *Mesodon diodonta*, Say. This species occurs sparingly, and seems to have its vertical limit with *thyroides* and *profundus*, at about 4,500 feet. At least this is as high as we have collected it. The shells differ in no respect from other Appalachian examples of the species from the north and east.

9. *Mesodon wetherbyi*, Bland. Shells, which have been referred to this species, have been collected here by us, and were taken by myself and students in 1881. In my Notes on American Land Shells, published in this Journal for that year, I fully discussed the differences between this form and the typical *wetherbyi*, and suggested its relationship to *Triodopsis*.

Recently (*The Nautilus*, May, 1893,), the eminent Conservator of Mollusca at the Philadelphia Academy of Sciences, H. A. Pilsbry, has, after quoting in full any remarks above referred to, described the present form as *Triodopsis subpalliata*. Upon a careful comparison, recently, with the types of *Mesodno wetherbyi*, I am inclined to believe that if we are to make species of these connecting links, this is as distinct as any of them, though in a series representing all the varieties of *dentifera, appressa, palliata* and the present form, it might be very difficult to say which are "species" and which are not.

FOSSIL FUNGI.

Translated from the French of R. Ferry, with remarks.

By Joseph F. James, M. Sc., F. G. S. A., etc.

The tenth volume of Saccardo's *Sylloge Fungorum Omnium* contains a long list of fossils that have been described as fungi at various times. The list includes about 330 species distributed among forty-one genera. The author, Dr. Aloysio Meschinelli, prefaces the list with some remarks in Latin, a transcript of which, with some additional remarks, is published by M. Ferry.* As Dr. Meschinelli's work and that of M. Ferry are in volumes, which the paleontologist is not likely to consult, it has been thought that a reproduction of the latter's remarks would not be without its value. A few papers, to which neither Meschinelli nor Ferry have referred, will be mentioned at the conclusion of this translation. M. Ferry's remarks are as follows:

"Fungi begin to appear in the Carboniferous epoch, but they are very rare in this formation and those immediately succeeding; it is not until the Tertiary is reached that they are found numerous and varied; the species of the Tertiary alone greatly exceed in number those of all of the preceding ages. Those of the Quaternary epoch, although not very numerous, are of a higher rank and a more complex structure. But it is not until our own time that they attain the height of their development.

"The author inquires into the reason for this progressive march. Fungi live by the destruction of other beings. All the causes, therefore, that hasten and facilitate decomposition of these should aid in the development of fungi.

*Revue Mycologique, April, 1893, pp. 54-56.

"Among these causes, we have placed in the front rank variations of temperature and the hygrometric state of the air. Apparently, at the time of the Carboniferous epoch, these conditions were but little favorable; the heat and the humidity were spread alike over all the surface of the earth; the seasons had no existence. It was not until the beginning of the Tertiary epoch that these became apparent and were clearly distinguished; it was only then that the alterations produced in atmospheric conditions can be compared with those that are exhibited at the present time.

"The paucity of fossil fungi relative to the other vegetation is explained by their soft, fleshy structure, which is but little liable to become petrified, and soon becomes destroyed without leaving a vestige.

"Of the crowd of fleshy fungi that exist to-day, very few are known in a fossil state; and yet of the former existence of many of them, we have proof in the remains of insects that live upon fleshy fungi to the exclusion of all other substances.

"It is for the same reason that the greater part of fossil fungi are those known as epiphyllous species.

"Their bad state of preservation, the impossibility of submitting them to a microscopic examination, allow a doubt to be cast upon the species and frequently on the genus. One can only determine them by their external form. Even for the epiphyllous species the characters that one finds are reduced to a small number; the general form, the margin, the number of papillæ, the umbilicus, or the central monticule, the ostiolum, the furrow, the longitudinal cleft, the surrounding crown, the color of the perithecia, their mutual arrangement, their situation on the upper or the lower surface of the leaves, such are the external characters that one finds for verification, little fit to characterize the species; at the most, suitable for the genera or the orders.

"It has thus become necessary to limit one's self by connecting with the genus *Sphærites* [for example], different genera of *Sphœriaceæ*; the same with the genus *Xylomites*, the different genera of the family *Ustaligineæ*.

"For these reasons the author has added to the names of the fossil fungi the final syllable *ites*, for the purpose of dis-

tinguishing them from those still living, to which they are related, but with which they do not entirely assimilate.

"In consequence of the incomplete descriptions, the imperfect figures, the author has not devoted himself, as he would like to have done, to the work of revision of species; he has set himself to gather all that seem to him worthy of note, thinking that such information will serve for the study and comparison of species that may afterward be discovered.

"The genera of *Hymenomycetes* are *Agaricites*, *Lenzitites*, *Polyporites*, *Dædaleites*, *Trametites*, *Hydnites*, and the names indicate the relationship to living genera; as for the genus *Archagaricon* Hancock and Atthey, it has no living analogue, but it shows frequent orbicular conceptacles; it is also characterized by the branches of the filaments (hyphæ) terminating here and there in vesicular swellings; the existence also of spherical bodies considered as spores. The five species that form the genus are found in the coal schists of Northumberland, England. The *Phycomycetes* are represented by the genera *Peronosporites* and *Protomycites*, both these also found in the coal; the *Hypodermeæ* by the genera *Puccinites* [*Phelonites*] *Æcidites;* the *Pyrenomycetes* by the genera [*Eurotites*] *Rosellinites*, *Leptosphærites*, *Trematosphærites*, *Sphærites*, *Polystigmites*, *Dothidites*, *Hysterites;* the *Discomycetes* by the genera *Pezizites*, *Cenangites*, *Phacidites*, *Stegites*, *Rhytismites:* the *Sphæropsidæ* by the genera *Depazites*, *Excipulites*. The *Hyphomycetes* so fragile and so fugacious have been preserved in the amber of the Baltic Sea and Arctic Ocean, and this has permitted us to have a knowledge of the delicate details of their organization; it is thus that we have in a fossil form the analogues of our *Oidium*, *Penicillium*, *Streptothrix*, *Brachycladium*, and even in the bodies of insects *Botrytis tenella* and *Sporotrichum densum*. We have also found mycelia analagous to *Xyloma*, *Rhizomorpha*, *Sclerotium* and the productions analogous to *Erineums*, and due, without doubt, as in those now living, to stings of insects.

"To this long enumeration of fossil fungi, given by Dr. Meschinelli, we may be permitted to add another, *Bacillus amylobacter*. M. Van Tieghem has found this bacterium, with its special forms, in thin slices of silicified wood from the coal terrane of St. Étienne. Thus, this species has existed with-

out variation through the long period that separates the present epoch from that ancient time.*

"There are likewise some species of bacteria which, he thinks, should be admitted as existing contemporaneously with the most ancient vegetation. They are the ones that produce in the soil chemical changes necessary for the nutrition of plants.

"Such is the bacterium of nitrification, of Schlœsing and Müntz, that transforms ammoniacal salts into nitrates, and thus gives to vegetation nitrogen in a form that permits of its assimilation. The importance of this has been demonstrated by the experiments of Duclaux; he has proved that when seeds of plants are grown in a soil deprived of bacteria, there are obtained slender, wretched specimens, as feeble as those that had been grown in pure water."†

[Several other papers describing fossil fungi, have been overlooked by Dr. Meschinelli, besides those mentioned above by M. Ferry. One of these was by Prof. P. Martin Duncan, in the Proceedings of the Royal Society of London.‡ In this paper attention is called to certain canals occurring in recent corals, to which the name of *Achlya penetrans* is given. Studies made of corals from the Silurian and Tertiary formations, showed the presence of similar or identical canals. The modern coral parasite is regarded as the descendant, with little or no modification, of the early fossil form.

In 1879 a paper was read by Messrs. Cash and Hick before the Yorkshire Geological and Polytechnic Society, and was published in their Transactions.|| In this paper were described some fungoid bodies found in the stems of ferns. Many hyphæ were present, and these were observed to be constricted

*Van Tieghem. *Sur le ferment butyrique (Bacillus amylobacter) à l'epoque de la houille.* (Comp. rend. des Sci. de l' ac. des Sci., 1879, vol. lxxxix, p. 1102. M. Müller, without going so far back, has found the filaments of *Leptothrix buccalis* in the tartar of the teeth of Egyptian mummies. (*Der einfluss der micro-organismen auf die Carie der Zahne. Archiv. für experim. Pathologie*, vol. xiv, 1882.

"†Duclaux. *Sur la germination dans un sol riche en matieres organique, ou exempt des microbes.* Comp. rend. de l'Acad. des Sci., vol. c, 1886, p. 68."

‡*On some thallophytes parasitic within recent Madreporaria.* Proc. Roy. Soc. London, vol. xxv, 1866, pp. 17-18, 238-257.

||Vol. vii, 1879, pp. 115-121. Also noticed in *Science Gossip*, vol. xvi, London, 1880, p. 67.

at certain points, giving them a moniliform appearance. Certain round bodies found associated were supposed to be oöspores, and the fungus itself was supposed to be related to the *Peronosporeæ*. Other specimens, consisting mainly of large numbers of spore-like bodies, were thought to be allied to *Myxomycetes*. Their size and appearance agreed "almost exactly" with that of existing species.

Still a third paper, of a more recent date, is by Prof. R. Etheridge.* In this a new genus is established for the reception of a species of fungus found in specimens of *Stenopora crenita*, under the name of *Palæoperone*, the specific name being *endophytica*. The species is regarded as belonging to the Saprolegniaceæ T.]

Still more recently, Mr. H. Herzer has published† a description of what he calls a fungus from the Coal Measures of Ohio, under the name of *Incoloria securiformis*. The specimen was found beneath the bark of a species of *Sigillaria*. It is of quite an anomalous character, and its true relations can not be ascertained from the published figure and description.

*On the occurrence of microscopic fungi, allied to the genus *Palæachya*, Duncan, in the Permo-Carboniferous Rocks of New South Wales and Queensland. Geol. Sur. N S. Wales, vol ii, Sydney, 1891, pp. 95-99, pl. 1.

†Am. Geologist, vol. xi, June, 1893, pp. 365-366.

REMARKS ON A CURIOUS FELT-LIKE MASS OF FUR FROM AN ANGORA CAT.

BY CHAS. A. PARKE.

A short time ago I handed Dr. Langdon a thick mat of fur, about the size of an old-time plaster, and explained that it had been cast by my Angora Tom Cat. At the following meeting of the Natural History Society, I was severely catechised by the members regarding the peculiarities of this breed of cats. The principal of these are the long hair — in some cases three or four inches long — parting down the middle of the back and falling on either side and the bushy tail, the animal resembling a raccoon more than a common house cat. The mat of fur is shed by the male only, and this occurs in the Spring. It is pushed off by the new hair growing under it, and becomes about three-quarters of an inch thick, and if let alone would be as large as the whole exterior surface of the animal, except the under part; but it is cut off to relieve him.

I was unable to give any facts of a scientific nature, but gave a short history of this particular family of cats. In the Winter of 1839–40, Madam Von Bärenstein, a German lady, was traveling in this country, and visited New Harmony, it being then a place of interest on account of having recently been the seat of the Rappite and Owen communities. She carried with her, as pets, a pair of these so-called African cats, to which she must have been much attached. She carried them about the country in those ante-railroad days, when traveling was done principally by stage coach. She found them too much trouble, however, and left them at New Harmony. From this pair have sprung the present stock that are there, and all that I have ever seen or heard of have been traceable to these. The original pair are described by old citizens as being jet black, and about twice the size of

ordinary cats, their long fur and meteoric tails spreading terror among the rest of the feline species, and even putting most of the dogs to flight. The male lived to be sixteen years old.

They are called "African," but that is probably a misnomer, as I learn that the long-haired cats spring from Syria, and are called after the city of Angora. It seems that Syria and Persia are noted for imparting the long, soft hair to many common animals which are bred there — sheep, goats, dogs, rabbits, etc. The fact of the pair in question being black I can not explain, except on the supposition that they were mixed. The long hair would tend to prove their Syrian origin.

THE HISTOLOGY OF THE STEM OF PONTEDERIA CORDATA, L.

By E. M. Wilcox, Columbus, O.

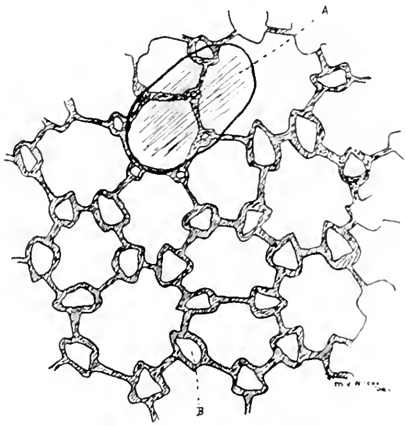
The histology of aquatic monocotyls has received the attention of few workers. Perhaps the most important contribution to this subject is by J. Duval-Jouve: "Diaphragmes vasculiferes des Monocotyledones Aquatiques," in Memoires de l'Academie de Montpellier, 1873, T. viii, pp. 157–176. Taf. vii. This article is reviewed in Botanischer Jahresbericht, erster Jahrg., 1873, pp. 195–7. Reference was also made to Meyen's Phytotomie, containing a discussion of this subject, to which, however, I have not had access.

Pontederia cordata, L., is an aquatic plant with thick rootstocks, producing erect, long petioled sagitate heart-shaped leaves, and a one-leafed stem bearing a dense spike of ephemeral blue flowers. The plant is widely distributed, extending from Canada to Florida, and west to Texas and Mexico, not usually abundant in any one place. It is often seen forming a beautiful blue and green covering for a slow flowing stream.

I have recently had opportunity, in the Botanical Laboratory of the Ohio State University, to devote some time to an examination of the stem of this plant. The most interesting points in its histology are briefly given below.

The diaphragms or transverse walls (Fig. 1), dividing the continuous air cavities into many chambers, consist of polygonal cells with a triangular (seldom rectangular) intercellular cavity (Fig. 1, B.) at each angle. These cells contain from ten to twenty chlorophyll grains. These diaphragms entirely cover one of the air spaces in the stem, but do not, as a gen-

eral rule, reach across the larger central cavity They probably serve two purposes: first, to allow the passage of air, and second, to act — as suggested by J. Duval Jouve — as supports for the fibro vascular bundles. In a few of the cross sections



I

Fig. I.

made, the diaphragm was for a distance composed of a single layer of cells, and the remaining portion was divided into two parts or layers. In this manner a cavity was formed with convex boundaries.

There are in the transverse membranes several cells projecting upward and downward, containing raphides (Fig. 1, A). Along with these are cells, containing a secretion, having a reddish color. These are about the same size as the surrounding cells, but they are round. In the membrane or diaphragm there are several lanced-shaped crystals that have broken out of the cells once containing them, and appear as long rods piercing the tissue.

The closed fibro-vascular bundles (Fig. 2), surrounded by one or two layers of parenchymous cells, have a very definite and similar shape. The position of the constituent cells in regard to each other, is quite regular in the different bundles. In cross section (Fig. 2) they are about twice as long as broad, with the bast tissue at each end extending toward "peculiar

starch cells" on each side of the bundle. Within the bast is the woody tissue, with a few rather large spiral vessels in the center.

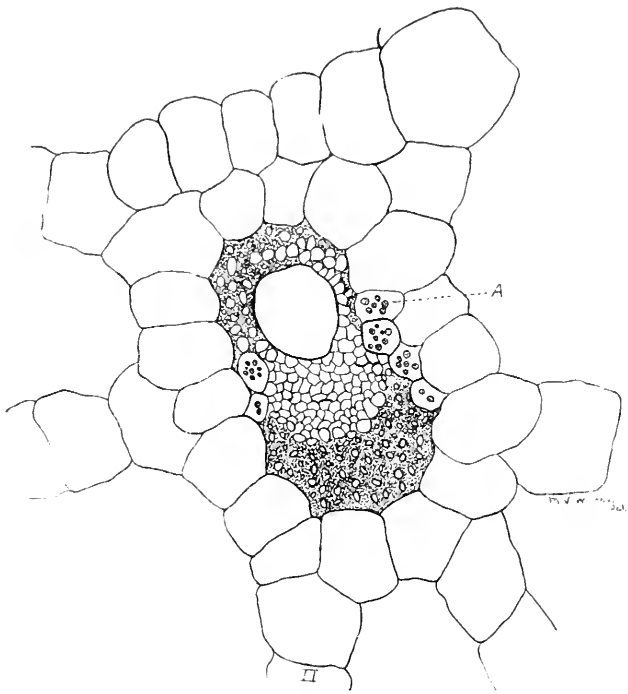


Fig. II.

At each side of the bundle, midway from the ends, there are from one to three specialized cells, containing a few starch grains (Fig. 2, A). These cells are roundish, parenchymous

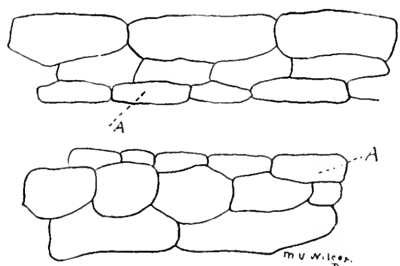


Fig. III.

cells, in which this plant stores up its starch. In the longitudinal section (Fig. 3), through the bundle, the starch cells (Fig. 3) are seen on both sides, and along the whole length of the bundle. Thus, here we see that starch is stored up in specialized cells — cells with a definite position in regard to some other fixed organ.

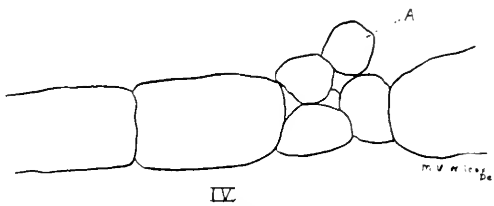


Fig. IV.

EXPLANATION OF THE FIGURES.

FIG. I.— A portion of a diaphragm very highly magnified, showing the polygonal cells, and at B the inter-cellular spaces. A. Is a cell containing raphides.

FIG. II.— Cross section of a fibro-vascular bundle, surrounded by the parenchymous tissue. A. Specialized starch cells, containing a few grains.

FIG. III.— Longitudinal section through a fibro-vascular bundle. A. Specialized starch cells each side of the bundle. The bundle itself is purposely omitted.

FIG. IV.— Longitudinal section, showing attachment of diaphragm to the other parenchymous tissue. The cell marked A contained chlorophyll grains.

INVESTIGATIONS OF THE BURROWS OF THE AMERICAN MARMOT.* (Arctomys monax.)

By William Hubbell Fisher, Cincinnati, Ohio, U. S. A.

I. NARRATIVE AND DESCRIPTION.

It was in the Summer of 1889 that I had become interested in the American Marmot. This animal is commonly known as the ground hog, or woodchuck.

I suggested to the farmers that I had some intention of unearthing a woodchuck in his hole. Some informed me that I could not find him, if I did dig, because the animal would dig faster than I could, and would escape. I inquired: Where did the woodchucks die? To this question I got no satisfactory answer. One man told me that if a woodchuck died in his hole, no other woodchuck would ever inhabit it.

As to what the woodchuck did above ground, all were a unit. They also agreed that he was good for food; made a nice dish when properly cooked and served; should be drawn immediately after death, and be thoroughly washed to avoid an odor and taste which otherwise would permeate the flesh; that he ate vegetable food; that he was a desperate fighter; that in that county, viz: Lewis County, New York, he went into his hole about the time frost began to come in the Fall, and stayed there until the snows had disappeared in the Spring; that he was very fat and plump in the Fall and thin when he reappeared in the Spring; that the young born under ground came forth in the Spring and rapidly grew to maturity; that the coat of hair was poor in Summer and good in Fall.

I may here remark that the price paid for these pelts is small.

I decided that I would investigate their burrows, and gather as much information about their underground life as possible.

I, therefore, prepared for action. I provided myself with memorandum paper and pencil and a pocket tape line. My photographic apparatus stood ready. The assistance of our gardener, Joe, was promised when needed.

I started out to make a preliminary survey. To tell you the truth, I was very anxious to find a burrow in which a woodchuck was known to live. Given two holes, one in which a woodchuck was known to be and one in which it was uncertain whether I would find him, and the instinct of curiosity and of the hunter so far predominated as to lead me to decide to investigate where the living plunder was to be had.

One afternoon, the farmer, while ploughing over a field, high and level, in which corn had been raised, and from which the plough-share threw up the nests of jumping mice, informed me that a woodchuck had a few minutes previous gone down into a hole by a stump, standing far out in the field. I summoned our faithful Joe, and each of us, armed with a shovel, proceeded to the stump. Here we began to dig, following down the hole. The latter ran under the stump, ramified a little, and then ran horizontally some two feet below the surface for about five feet, and then descended rapidly nearly two feet more in an additional length of some three and a half feet. Not a sign did we see of our much sought for woodchuck.

During the excavation, we expected that every new spadeful thrown up would lay bare our much-sought-for treasure, but it did not. Where that marmot had gone was an inexplicable mystery. We confronted the farmer and told him that his eyes must have deceived him. He laughed and stoutly affirmed he saw the woodchuck go into the hole, and was satisfied he had not come out. As it was near supper time, we gave up the unequal search, and, like a hunting dog foiled in his trail, went slowly home, with our spades in hand, wondering what had become of that woodchuck.

The next day, as digging marmot holes was now my business, I repaired to the open ditch we had yesterday dug and

had not filled. Lo, to my surprise, I found at the side of the ditch and on a level with the passage, which was about two feet below the surface, a new hole. Aha! Here it was the chuck had hidden. But how was it that we saw no traces of this hole when digging? When we left the ditch, the place where this hole was, was a part of one continuous wall of sand, without break or check to indicate that any hole was here. Subsequent investigations cleared up the mystery.

Before pursuing the specific descriptions of excavations which I have made, let us pause to keep in mind, as this address proceeds, certain questions which have presented themselves. First: To what extent does the marmot or marmots, in digging out the burrow, carry the loose dirt to the entrance on the outside of the entrance? How many entrances has a burrow? Do the marmots have special stopping places in their burrows? Are nests or lairs there present? Do they dig and use only those burrows in which they finally winter, or hibernate at the close of the Summer and the coming of frost? Do they select any special descriptions of soil? If there be any descriptions of burrows employed especially for hibernation, what are they?

The excavation of a given burrow is lettered, and the letters follow in the order of time these excavations were respectively made.

EXCAVATION A.

This burrow was located in high, level, sandy, grassy soil. To the north of it, a few rods distant, lay a deep valley. To the south of it a few rods lay somewhat higher land, terminating in a woodland. Each end of the runway terminated in an opening at the surface, and each of these openings appeared to be indiscriminately used for entrance to the runway and exit therefrom. These openings were large and of ovular form. The western opening was twenty-two inches long, the eastern one seventeen inches in length. On the inner or east edge of the western opening, sand, evidently taken from the hole, was piled. No pile of sand was present on the west edge. On both the east and west edges of the entrance B piles of sand were present. Why this difference existed, I do

not know. It may have occurred either from accident or design The woodchuck is supposed to dig with his head toward the part he is to excavate. But, as we shall see, he is capable, after located in his hole or runway or a part of it, of facing toward the mouth of the hole, and forcing up the dirt from around him and placing it in front of him. Possibly, the marmot, in digging the east entrance, viz.: at B, dug part of the time with his face toward the east edge of the hole, and part of the time with his face toward the west edge thereof. Sand thus thrown out would be then lodged at both edges, as I found it.

As is natural with almost any class of diggers, that portion of the runway at each entrance, which continued farther in there served as the roof, is more perpendicular than that portion which continued on as the floor or bottom of the way. The runways rapidly narrow in both diameters, and as they reach that portion of the way which is substantially horizontal, they are of a size to allow an adult marmot to readily pass through. No arrangements appear to be made for two marmots happening in one runway, either by accident or design, and coming toward the center from the opposite entrances to pass, unless the part now to be described is utilized for such purpose.

The runway runs from entrance A, east by north, for forty-three inches to a; thence runs north-east by east for thirty-one inches, and then turning at an angle runs east by south for twenty-two inches to C, whence it resumes the general direction of east by north. It is interesting to note how straight the general direction of the runway is, and how the general direction, east by north, is resumed after passing point C, and continued in substantial alignment with the part A to a.

The point in the way, which is deepest below the surface, is at C, viz.: thirty-one inches. At the point B, the highest and consequently the driest point in the bottom of the runway, is an offset recess, probably serving the purpose of a lair or nest in connection with the runway, the lair proper, exclusive of the runway, being only six inches deep. The entire length of the runway (exclusive of lair) is fourteen feet, eleven inches.

EXCAVATION B.

Excavation B was located not far from excavation A, in similar soil, on the same elevation as A, but somewhat sloping at its southern end. The burrow was provided with three entrances, hole No. 1 to the north; hole No. 2, five feet and a half in an air line from No. 1; and hole No. 3, still farther to the south, and distant from hole No. 2 in a direct line eight feet. The distance between holes Nos. 1 and 3, in a straight line, was thirteen feet and nine inches. Hole No. 1 was out in the meadow and so was hole 3, but entrance No. 2 was under an old stump, overshadowed by an elder bush and surrounded by raspberry bushes. It will be observed from hole No. 1 that the runway extends forty-five and a half inches to A, then turns and runs south of south-east thirty-three inches to B, and then, in an almost straight line thirty-seven inches, proceeds to C. From hole No. 2 a runway extends north-east in an almost straight north-east line to B, a distance of seven feet, two inches, where it intersects the first runway. From hole No. 3 a runway extends a little west of north for six feet, eleven inches, and then in a northerly direction, but a little more to the west, for three feet and one inch to D, where it intersects the runway from entrance No. 2 to B. As to depth, the runway, from entrance No. 1 to the point C, was a continual descent, the point C being of a remarkable and uncommon depth, to-wit: forty-seven inches. At B it was a not unusual depth, viz.: thirty-seven inches. The runway from B to D continues about on the same level, and so does the runway from D to rear entrance three, but as the surface of the ground descends the runway gets nearer to the surface. At N, some thirty inches from entrance No. 3, occurs a nest or lair.

Three points of added interest, deducible from a comparison of this excavation with excavation A, are: First. The runway, from entrance No. 1 to C, continually descends till it reaches the depth of forty-seven inches. Second. The farther end C of the picket or blind runway, from B to C, is such that if moisture enters the runway, this point C would be the wettest. On the other hand, it would be the warmest for hibernation. Third. The lair or nest does not occur at the

middle of the runway, nor near the intersection of two branches, but lies near one of the entrances.

An interesting query rises: At what point did the marmot begin his excavation of this burrow? I opine he began at the old stump, entrance No. 2.

EXCAVATION C.

With excavation C the locality changes. We are now transported over one-half mile distant from the burrows A and B. The burrow C lies on the edge of a beaver meadow, where the ground is low, and in rainy seasons quite wet. It lies at the foot of a range of hills located to the east, and from their inclined western face the water descends into this beaver meadow.

When I began excavating here, I expected, without doubt, to find a marmot within, but failed to do so.

This burrow had three entrances. The northern-most one A and the southern one B were in a line running nearly due north. A surface track, made by marmots, extended in a straight line from entrance B to entrance A, viz.: fourteen feet, five inches; thence this surface track extended thirty-seven feet through the grass to a clover patch, whose nearest edge was thirty-seven feet north of entrance A. This thirty-seven foot track was not perfectly straight, but with slight angulations or windings, right and left, reached the clover patch at a point nearly due north of the entrance A. Below ground the burrow gradually descended, in a direction due east, for a distance of twenty-eight inches, to where the vertical distance from the surface of the ground to the bottom of the burrow was thirty inches. The burrow then turned to the south, and at c the lowest point was reached, the runway below a horizontal surface level of entrance A continually descending to this point. On account of the simultaneous rise of the surface of the ground, the vertical depth is forty inches, but here the bottom of the burrow is ascending, and continues to ascend to e, where a solid rock was reached at its west wall. At this point, twenty-six and a half inches from the surface to the bottom of the runway, the latter enlarged and a branch way extended east, south of east, nearly

on a level to a point p, distant from e about six feet, six inches, and then ascending terminated in the entrance or exit C. Just south of the intersection of this branch with the main runway, a large nest was present, twenty-four inches across from east to west, and fourteen inches from north to south. The peculiarity of this nest was that it was not a mere enlargement of a semi-circular description on the side of a runway, but it constituted a distinct chamber connected with the enlarged area at the intersection of the main runway and the branch leading to C, by a distinct, short, narrow runway. Thus great privacy could be maintained in this chamber, and at the same time the occupant or occupants could be cognizant of any living thing which passed through the main runway, or the branch thereof from e to C. To return to the main runway. This extended from the enlarged intersection in a south-westerly direction to g, and at the same time gradually descending. Here its bottom was thirty-six inches below the surface of the ground, the latter also gradually ascending to this point. From g, the ground surface gradually descended to the entrance B, and the runway gradually ascended. The direction of the runway from point g changed to a direction east of south.

It will be observed that the nest is located on a level with the bottom between e and f, and, therefore, is elevated so that moisture in the main runway will seek the points C or g, and will not reach the nest. This is not true of the branch runway to any extent. One other interesting feature consists of a great mound of earth cast up at and south of the entrance B. This mound was four feet, nine inches from east to west, and four feet from north to south. The highest point of the mound was nine and a half inches above the general level of the ground about it. It was covered with grass, except the central portion, and a path from there to entrance B. This path was below the general level of the mound. These facts would indicate that the mound was formed by the earth taken from the runway, and that its elevation was made use of as the nearest post of observation, close at hand to the burrow.

EXCAVATION D.

Part of the clover patch hereinbefore mentioned was on the same level as the land in which the burrow laid bare by exca-

vation C was made, and in the same character of soil, but a northern portion of this patch rose on a slope and continued on higher ground to a straight line of fence, and had more gravel in the sand. Upon this high ground and on the side of the hill, facing nearly west, occurred the burrow laid bare by excavation D. The northern entrance B was about thirty-five and a half feet south of the fence, and the entrance A about forty-two feet south of the fence.

The northern entrance B of the burrow was distant thirteen feet and seven inches from the southern one A. The underground direction from the northern entrance is straight to b, and the direction (from b) is north-east by north, and the distance seven feet, eleven inches. From b the runway extends east by south-east to entrance A eight feet, two inches, making the total length of the runway sixteen feet, one inch. The runway descends from B to b, and at C is thirty-three and a half inches and at b thirty-six inches below the surface. From b to entrance A it gradually ascends, being thirty inches below the surface. Average depth of entire runway below surface, excepting near entrances, was about thirty-one inches.

West and south of entrance A, and touching the latter, lay a very large heap of sand, evidently thrown out of the runway. This heap measured six feet, two inches in length and three feet, two inches across, and was eight inches high. A measurement of the cross diameters of the runway at the point D (b) showed it to be nine inches wide by four and a half inches high. This indicates that the animal lies quite flat and in a comparatively compact position when passing through the burrow.

EXCAVATION E.

Another burrow near the last, and in ground on substantially the same level, is shown by excavation E. The entrance lay twenty-two feet from the north fence already mentioned. It was fifteen feet long and nine feet wide, while entrance C, lying nearly due east and located ten feet distant in a straight line, was sixteen inches long and eight inches wide.

The burrow ran south-east for twelve and three-quarter inches, then east fifty-nine inches, next north-east for five feet

to b, then a little north of south-east for six feet, two inches. The deepest point in this runway was forty-nine and one-eighth inches, viz.: at b. The runway did not continue on a level on any point, except from A to B, the latter being a second entrance only twelve inches from B, an uncommon circumstance. In the general averages hereinafter considered, this hole will be considered as one with entrance A. From the point b^1, a branch runway extended north-east for four feet, seven inches to b^2, where it reached the uncommon depth of four feet, seven inches. One would suppose the end of this pocket would not be a desirable place for an extended stay, as it would be probably moist. The average depth of this burrow was approximately thirty-four inches.

A very large earth mound, thrown up by the marmot from the runway, was present at the entrance A, and west thereof. It measured four feet, nine inches from the entrance A to its westward edge, and four feet, eleven inches in the other direction. Its greatest height was nine inches.

At the south-west edge of the entrance A were some choke cherry bushes. These afforded a blind, by the side of which the marmot might sit.

The entire length of the runways aggregated (260 inches) twenty-one feet, eight inches.

EXCAVATION G.

This runway was in a broad, elevated, flat meadow plateau, elevated about twenty feet above the runway (excavation) C of the beaver meadow.

The entrance A was close by a stump, and immediately descended under the same, and the runway continued on and ran in a straight line about north-west, then west for twelve inches and then north-west again for fifty-one inches, where it stopped.

The runway was substantially horizontal, and twenty-three inches below the surface — quite an interesting fact. From B to D a branch runway extended forty-nine and a half inches. The entrance A was ten and one-quarter inches long and six and one-quarter inches broad. Two heaps or mounds of sand adjoined it. A small mound lay to the east, and a large one,

twenty-five inches, to the south-west of the stump and of the entrance. Observe, so far as observation can decide, how the marmot carried the larger portion of the sand around from the entrance to the southwest side of the stump. A marmot was known to enter this burrow the day before I laid it open.

EXCAVATION H.

The most extended burrow I had occasion to excavate was excavation H. It was on a hillside, west of a beaver meadow, the side of the hill here facing south of east. The upper or northerly entrance was distant from the southerly one eleven feet in a direct line. Below, south of the upper hole, was a sand pile three feet, six inches long, but not as wide. A sand mound at the lower entrance B was about forty-eight inches from north to south (down the hill) and about three feet, six inches wide. A surface track between the holes was found, indicated by the dotted-line-marked track. The runway, from the northern entrance, extended west of south four feet, six inches to a, and the runway from south entrance B extended due north to a^2 and the adjacent ends a, a^2 of these runways were connected by a lair or nest twenty-six inches long.

A runway to b, distant six feet, one and a half inches from a, in a south-easterly direction, entered at b in a smaller nest, at a depth of forty-four and a half inches below the surface. The runway then continued from the other end of this nest for six feet, nine inches a little north of east to C, and then five feet, six inches to d, where it terminated in a circular nest forty-nine inches below the surface. Returning to point C, from here a branch runway extends south-east forty-two inches and terminates in a smaller pocket nest twenty-two inches deep (below the surface). This was not all. From the nest a, a^2 (first mentioned), a second branch runway extended three feet, ten inches to a^3, the center of a large nest, twenty three inches long by seventeen across; thence north-east to a^4, which from the point a^3 is three feet, six inches.

Just beyond here a sixth nest was found, and beyond the latter the excavation was conducted to a^5. This entire system of burrows smelled strongly of marmots. At a, their

fœces were discovered, an uncommon find in their burrows. At a^2 fœces and old straw.

In one of the nests I found the skull of a marmot, but no other portion of the skeleton. The nest was, if I recollect aright, the one marked a^3.

This find appeared to contradict the assertion made by a farmer, that marmots would never live in a burrow where a marmot had died.

EXCAVATION I.

Once more the scene changes again to the meadows, where the burrows A and B were located.

On Sept. 30, the digging began at 11.30 A. M.

The burrow was a plain and simple one. The entrance at first led rapidly down, then gradually descended to point A^1, eighteen inches below the surface, and then at about the same inclination of descent continued to B, twenty-two inches below the surface. Down to this point the burrow was through a sandy loam, but now descended quite rapidly through a layer of indurated clay (hard pan), six inches thick, for twenty-two inches to point C, here thirty-six inches below the surface, and continued twenty and one-quarter inches to D on the same level through a white sand. Between points C and D, at 12 o'clock, just one-half hour from when the digging began, we came upon a live, robust marmot, ready to do and die in his own defense. After reaching him, we watched him while a party was sent for a canvas bag.

Meantime the fellow gave us a specimen of his ability by filling up the hole in front of him and thus disappearing from view. The time occupied in this operation was one minute.

Having enjoyed this spectacle to our hearts' content, we concluded to bag the animal; so wedging down behind the animal, and poking him with a twig while a party held the bag in front of the hole we had again uncovered, the marmot went out of the hole into the bag we held, and thus we caught the fellow.

EXCAVATION J.

The last burrow excavated, viz.: J, was opened October 10. It was located under a large tree, and not many rods from

burrow I. A man told me he had seen a "chuck" go into the hole (entrance) A yesterday, and had put a barrel over the hole. To-day we observed the chuck had dug a hole under the north side of the barrel, and we presumed he had gone out through it, and were positive he would be frightened by the barrel and would not have returned. Nevertheless, we concluded to excavate. It was 2.40 o'clock when the first digging began. Entrance A was quite near to the tree. The burrow descended in a vertical direction, then continued in a gradual descent to the point C, twenty-one and a half inches below the surface, then ascended to point d, fifteen inches below the surface. The general direction from A was nearly straight, with a short bend from b to C. The burrow at d bent back and ran in a north-westerly direction on a descending grade, which point was ten inches lower than point d. At the point C, heretofore mentioned, a nest nine inches deep lay to the north east of the runway. Between the point or elbow d and the end g of the branch burrow, the latter was filled with sand between points d and e. This did not deceive us. We dug on and finally became aware of the vicinity of an active marmot before us in the burrow; time, 3.05 P. M. We sent for a bag, and upon its arrival proceeded to unearth our subterraneous friend. Meantime he had disappeared.

According to my best recollection, the marmot had dug and passed across from e to the main burrow, and remained in a part thereof, which I had not then opened from above. Not finding him at e, we dug along in the main burrow from d toward C. In the meantime he had filled the burrow immediately in front of him (he faced toward d when we found him) with sand. We spaded away his hole to within a couple of inches of his nose, and thus made the hole open at the end toward d. We then watched him.

The manner in which this marmot and the marmot found in excavation I filled or stopped the hole in front of him was as follows: He sat or crouched in his hole, his nose facing the aperture, and its tip some two inches from the edge of the hole. See illustrative diagram sketch No. 1. As nearly as I could make out, he appeared to bring dirt by his hind paws from within the burrow within reach of his front paws. With the latter he banked this dirt in front, directly across the

bottom of the hole. He continued a succession of these operations, thus partly filling the hole. See sketch No. 2. In half a minute more the hole was completely closed. See sketch No. 3. After a few minutes, I cut the holes open again by spading down. In doing this, I observed an interesting fact, viz.: the earth filled in by the marmot was packed very hard, and the line of juncture between the earth he filled in and the natural earth around his burrow was almost indiscernible. By spading away the earth he filled in, and cutting back the burrow a little and then resting, we had the pleasure of witnessing him repeat the operation of closing the burrow in front of himself and in front of us. Not only did I and the workmen then watch him, but others, including ladies and guests from the house, had the pleasure of observing the industry and rapid and effective operation of the marmot in closing the unexpected opening made in his burrow.

I am satisfied that the marmot will shut himself in a portion of his burrow, when he has reason to believe that those following him in his burrow by digging it open are likely to reach him. This fact is proven by the history of the first excavation cited in this paper, in the corn field, where the marmot went into a side branch of the burrow, closed up the entrance, and we following the main burrow, dug past it and did not discover it, and on reaching the end of the main burrow, gave up the search. After we left, and before we revisited the excavation the next day, the marmot dug out the earth with which he had closed the mouth of the branch burrow and came out of it and escaped, and in so doing left open the branch hole wherein he had previously lain secure.

The following tables are composed of measurements and averages. The measurements are matters of fact, and must stand. The averages are tentative, and subject to change, if required by subsequent investigation of additional burrows.

II. TABLES OF MEASUREMENTS, AVERAGES AND TENTATIVE GENERALIZATIONS.

	Greatest Depth of Burrow.	Aggregate Length of all Runways of a given Burrow.	Number of Entrances to a given Burrow	Number of Sand Mounds or Piles.	Size of Sand Mounds.
A	31″	14′ 11″	2	2	2 slight mounds at A, about 11″ long; at B, about 10″ long.
B	47″	26′ 9½″	3	None	None.
C	41″	28′ 2″	3	1	4′ 9″ by 4′
D	36″	16′ 1″	2	1	6′ 2″ by 3′ 6″
E	55″	21′ 8¾″	3, really 2	1	4′ 11½″ by 4′ 9″
G	23″	12′ 4½″	1	2 at 1 hole	1st pile, 24″ long; 2d pile, 11″ long.
H	49″	44′ 9½″	2	2, one for each Entrance	A, 3′ 6″ B, 4′ by 3′ 6″
I	36″	6′ 8¼″	1	None	None.
J	25″	15′ 1″*	1	None	None.
	9 | 343″	9 | 186′ 7½″	9 | 17	9 | 9	
	Average, 38 1/9″	Average, 20′ 8.83″	Average, 1 8/9†	Average, 1	

*9″ detour or jog, considered as a nest, and not included as runway.
†Excluding vent B of Ex. E.

	Number of Nests or Short Lairs.	Branches Ending in Entrance.	Number of Blind Branches or Pocket Runways.	Greatest Depth of Same.	Length of Blind Branches or Pocket Runways.
A	1	None	None	None	9″
B	1	1	1	47″	37″
C	1	1	None	None	30″
D	None	None	None	None	None
E	None	None	1	55″	55″
G	None	None	1	23″	$100\frac{1}{2}$″
H	6	None	3	$44\frac{3}{4}$″ 49″ 22″	246″
I	None	None	1	36″	$20\frac{1}{4}$″
J	1	None	1	25″	9″
	9 | 10	9 | 2	9 | 8	7 | $278\frac{3}{4}$″	8 | 506.75
	Average, $1\frac{1}{9}$	Average, $\frac{2}{9}$	Average, $\frac{8}{9}$	Average, $39\frac{23}{28}$″ 3′ $3\frac{23}{28}$″	Average, 63.343″

	Depth of Lowest Nest.	Note of Depth of all Nests.	Nests at End of Pockets, or Blind Runways.	Nests just at side of Main Runway and entering into same.	Nests in Intersections, or near same of three parts of Runway.	Nests in Single Runway, the latter running through it.
A	28″	28″	None.	1	None.	None.
B	34″	34″	None.	1	None.	1
C	26½″	26½″	None.	1	1	None.
D	None.	None.	None.	None.	None.	None.
E	None.	None.	None.	None.	None.	None.
G	None.	None.	None.	None.	None.	None.
H	49″	40½″ 44½″ 36″ 44¾″ 49″ 22″	2	None.	1	3
I	None.	None.	None.	None.	None.	None.
J	21½″	21½″	None.	1	None.	None.
	5 | 159	10 | 346¾	9 | 2	9 | 4	9 | 2	9 | 4
	31.8 2′ 7/8″*	34.675 2′ 10.675″†	2/9‡	4/9‡	2/9‡	4/9‡

*Average depth of lowest nest of those present. †Average depth of all nests present. ‡Average number of same to a burrow.

	∴ Distance of entrances apart in a straight surface line; where there are only two entrances, center to center.	Distance of entrances apart, in an air (surface) line, between two main entrances, when more than two entrances, center to center.	Distance of all entrances apart, measuring from nearest holes, hole to hole, in straight or air lines over surface, center to center.
A	192″		
B	....	168″	102″ and 72″ 174″
C	....	176″	173″ and 147″ 320″
D	176″		
E	192″		
G	None.		
H	144″		
I	None.		
J	None.		
	4 | 704″	2 | 344″	
	12 | 176″	12 | 172″	
	14′ 8″	14′ 4″	
	Average distance of entrances apart, in air-line surface measurement; where there are only two, center to center.	Average distance of two main entrances apart, in a straight air surface line, where there are more than two entrances, center to center.	Average distance of all entrances apart, measuring from nearest holes, hole to hole, in air lines over surface of ground, center to center.

	Distance of all entrances apart, measured along line of Runways, center to center.	Length of Burrows with Nest.	Length of Burrows without Nest
A	198½″	15′ 11″	14′ 11″
B	No. 1 to 2 168″ No. 2 to 3 = 159″	26′ 9½″	26′ 9½″
C	A to C 203″ A to B = 237″	30′ 2″	28′ 2″
D	103⅞″	16′ 1″	16′ 1″
E	221½″	21′ 8¾″	21′ 8¾″
G	....	12′ 4½″	12′ 4½″
H	159″	46′ 11½″	44′ 9½″
I	....	6′ 8¼″	6′ 8¼″
J	....	15′ 10″	15′ 1″
	8 | 1449.875″		
	Average, 181.238″		

	Distance of entrances apart between two main Runways, measured on the line of the Runway, when there are more than two entrances, center to center.	Distance of entrances apart, measured on the line of Runway, where there are only two entrances, center to center.
A	....	198½″
B	No. 2 to No. 3, 159″	
C	A. to B, 237″	
D	....	103⅞″
E	....	221½″
G		
H	....	159″
I		
J		
	2 | 396	4 | 682.875″
	Average, 198″	Average, 170.718″

EXPLANATION OF PLATES.

Plate III.

Fig. 1.— *Gigartinites antiquus* Brong., sp.

Fig. 2.— *Fucoides strictus* Brong; *a*. natural size; *b*. a small portion enlarged, showing dots along each side of a central depression.

Fig. 3.— *Licrophycus? circinatus* Brong., sp.

Plate IV.

Fig. 1.— *Gigartinites recurvus* Brong., sp.

Fig. 2.— *Gigartinites furcatus* Brong., sp.

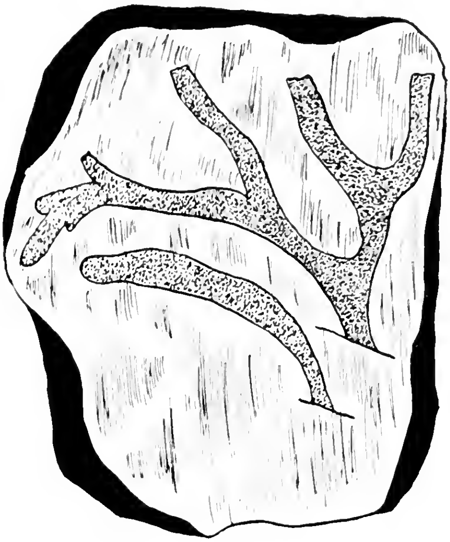
Plate V.

Fig. 1.— *Gigartinites furcatus* Brong., sp.

Fig. 2.— *Gigartinites difformis* Brong., sp.

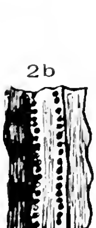
Fig. 3.— *Gigartinites targionii* Brong., sp. (This figure also shows a well-defined worm burrow.)

(All the figures are after Brongniart.)


1

2a


2b



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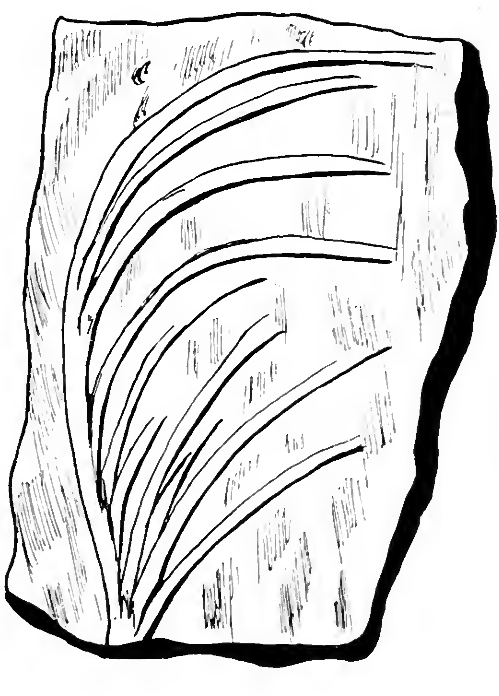

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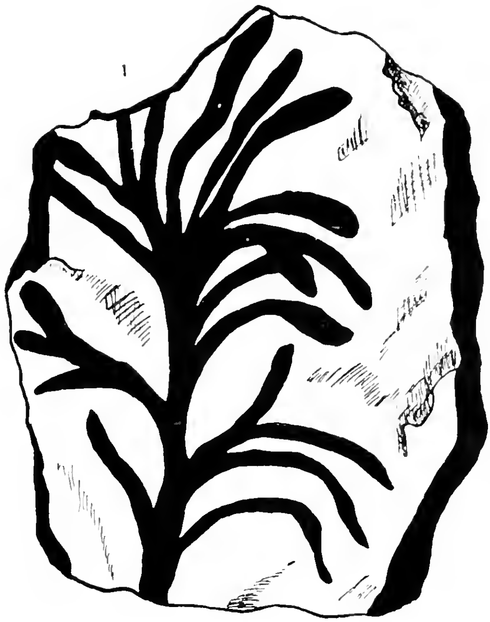

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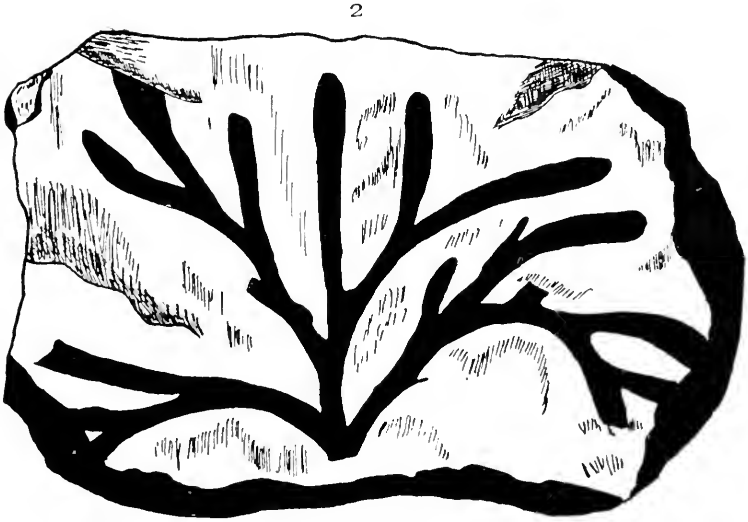

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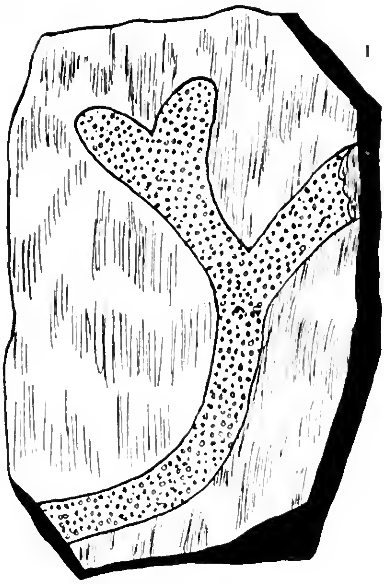

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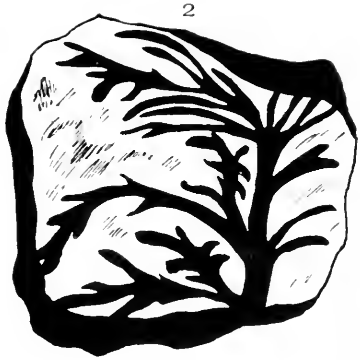

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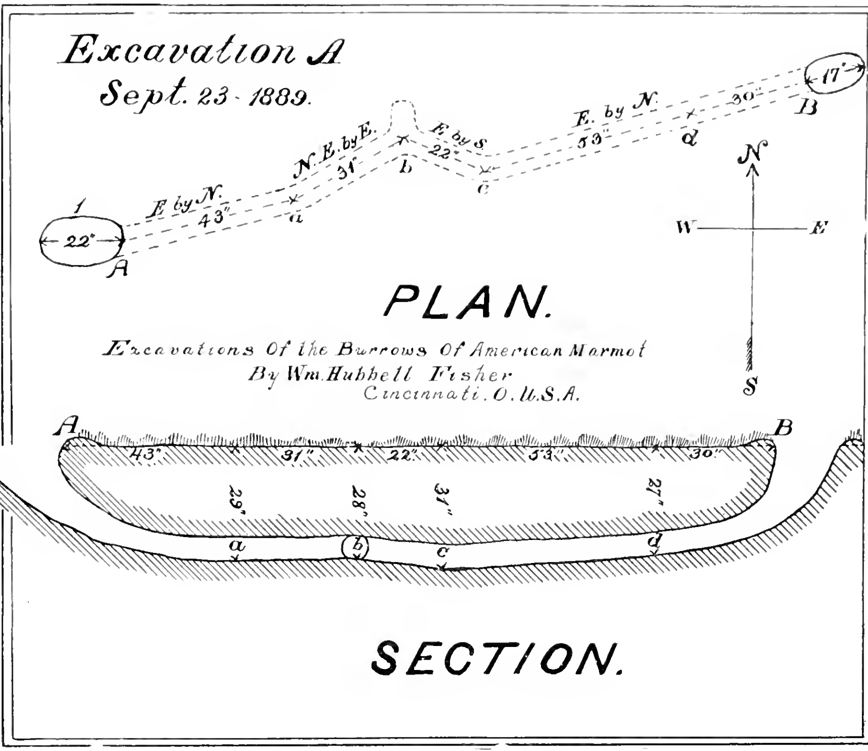
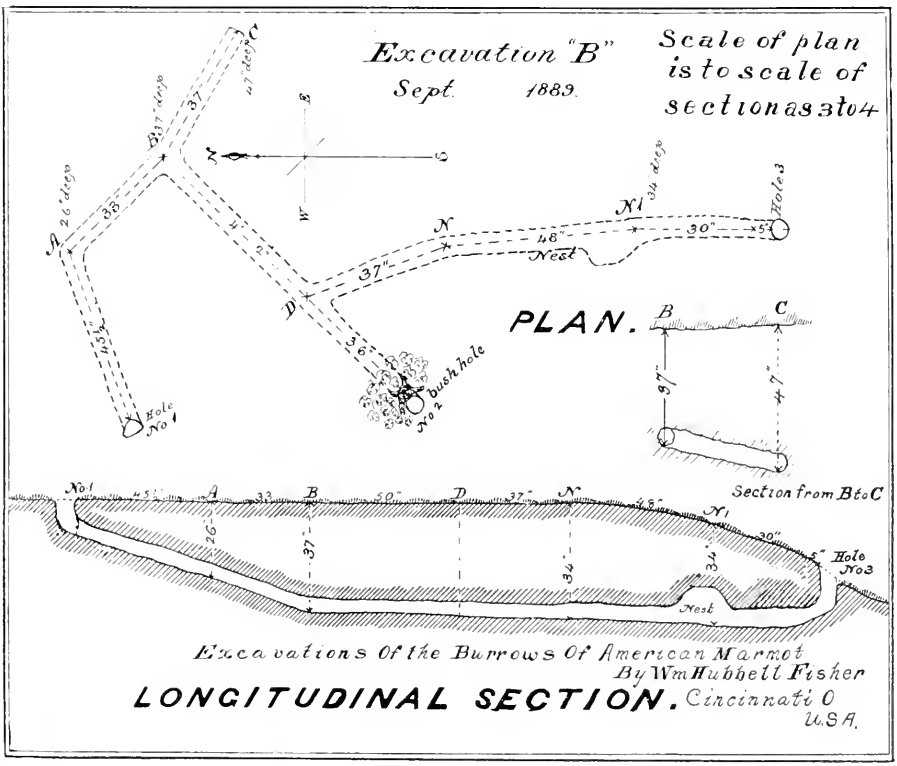
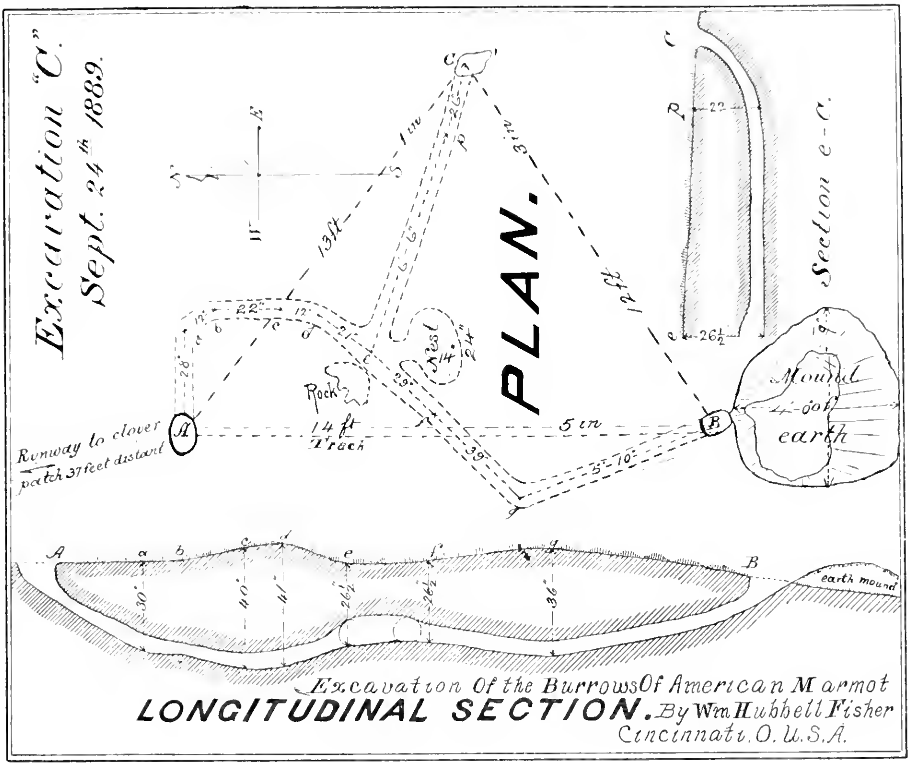
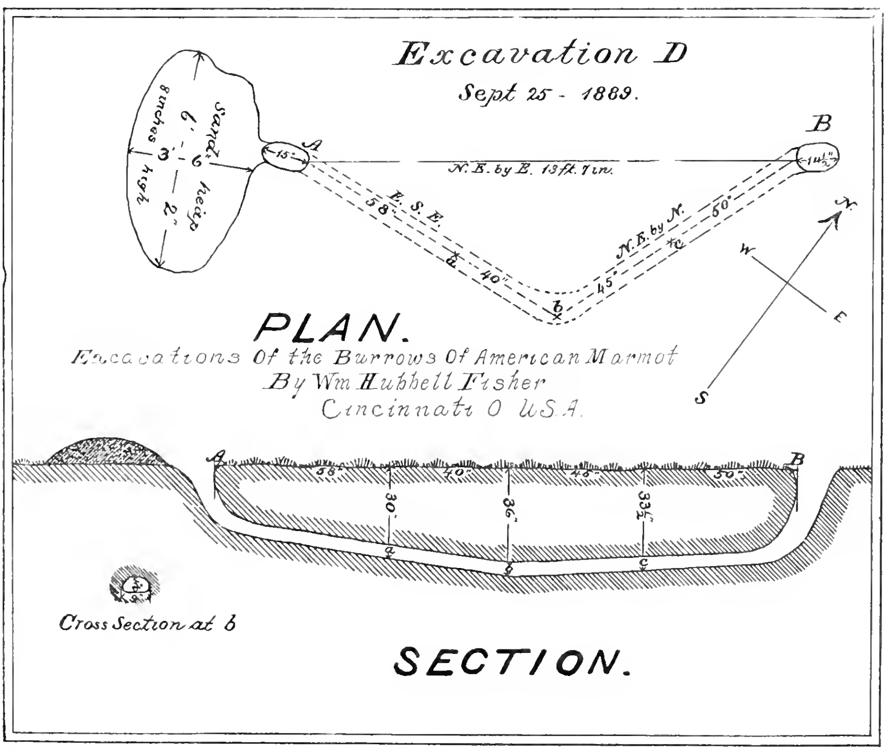
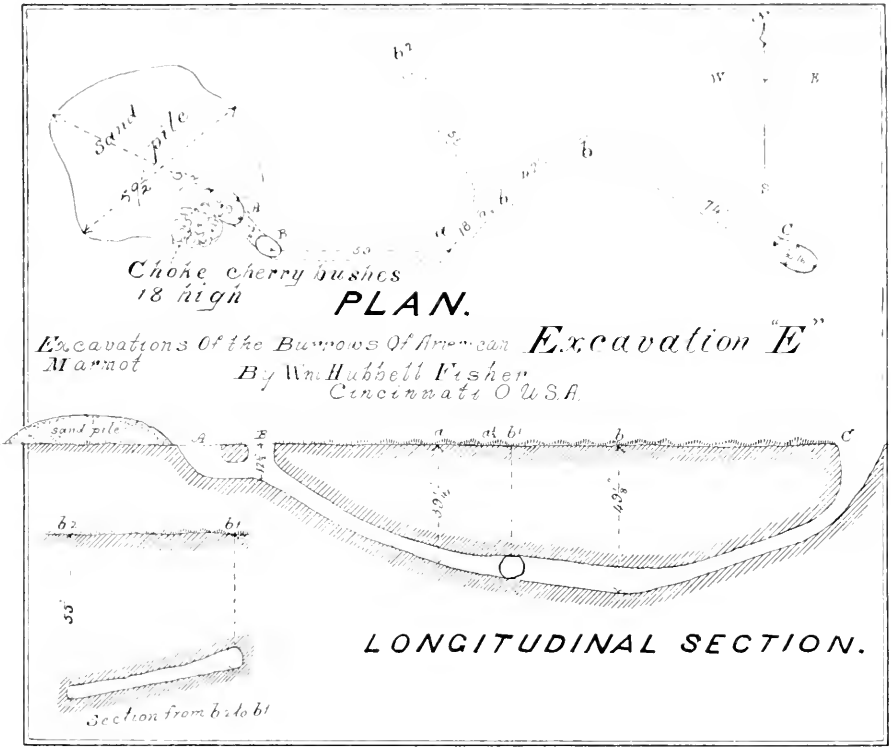
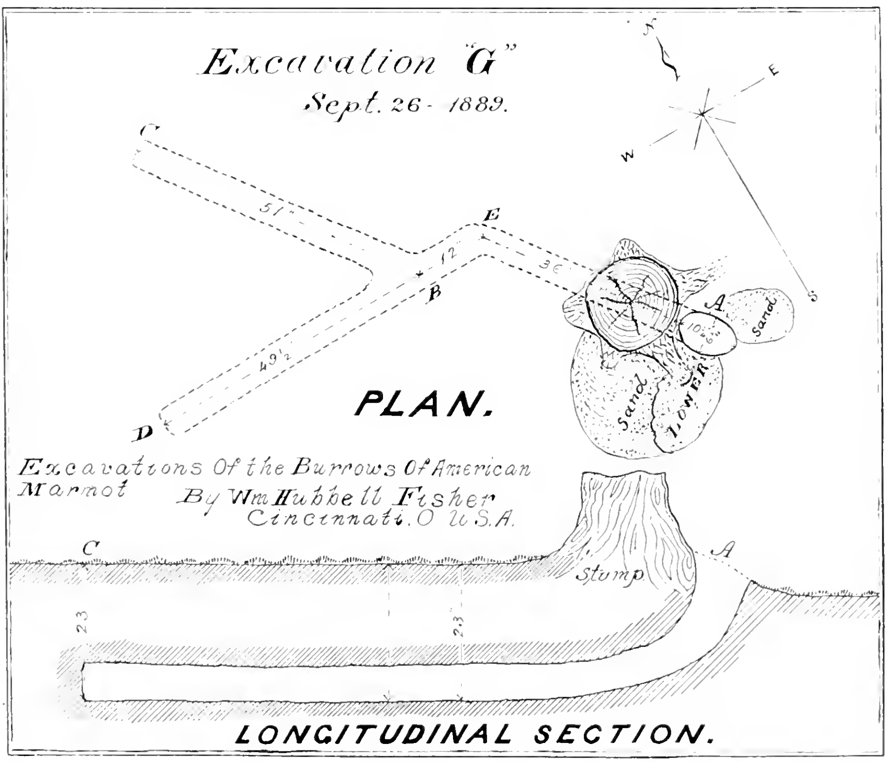

Excavation A
Sept. 23 - 1889.
PLAN.
Excavations Of the Burrows Of American Marmot
By Wm. Hubbell Fisher
Cincinnati. O. U.S.A.
SECTION.

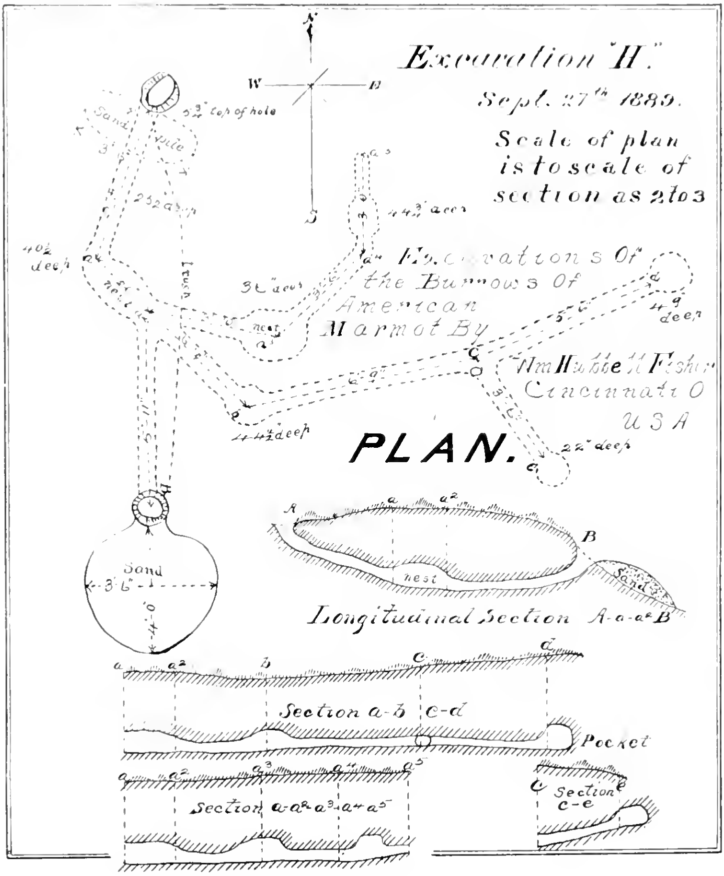

Excavation "B"
Sept. 1889.
Scale of plan is to scale of section as 3 to 4
PLAN.
Section from B to C
Excavations Of the Burrows Of American Marmot
By Wm Hubbell Fisher
Cincinnati O U.S.A.
LONGITUDINAL SECTION.

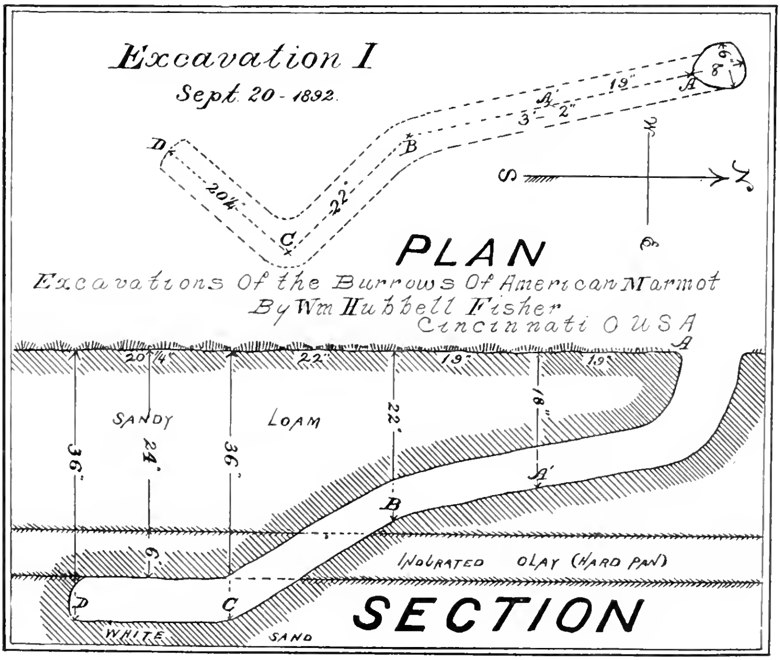

Excavation "C."
Sept. 24th 1889.
PLAN.
Section e-C.
Mound
4-foot
earth
Rock
Nest
Runway to clover patch 37 feet distant
14 ft
Track
5 in
13 ft
12 ft
earth mound
Excavation Of the Burrows Of American Marmot
LONGITUDINAL SECTION. By Wm Hubbell Fisher
Cincinnati, O. U.S.A.

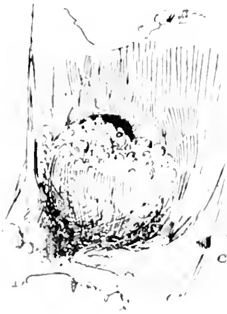

Excavation D
Sept 25 - 1889.
Sand heap
6' - 6
3' - 2"
8 inches high
N. E. by E. 13 ft. 7 in.
E. S. E.
N. E. by N.
PLAN.
Excavations Of the Burrows Of American Marmot
By Wm Hubbell Fisher
Cincinnati O U.S.A.
Cross Section at b
SECTION.


Sand pile
Choke cherry bushes 18 high
PLAN.
Excavations Of the Burrows Of American Marmot
By Wm Hubbell Fisher Cincinnati O U.S.A.
Excavation "E"
sand pile
LONGITUDINAL SECTION.
Section from b2 to b1


Excavation "G"
Sept. 26 - 1889.
PLAN.
Sand
Excavations Of the Burrows Of American Marmot
By Wm Hubbell Fisher Cincinnati. O U.S.A.
Stump
LONGITUDINAL SECTION.


Excavation "H."
Sept. 27th 1889.
Scale of plan is to scale of section as 2 to 3
Excavations Of the Burrows Of American Marmot By Wm Hubbell Fisher Cincinnati O USA
PLAN.
Sand
nest
Longitudinal Section A-a-a² B
Section a-b c-d
Pocket
Section a-a²-a³-a⁴-a⁵
Section c-e


Excavation I
Sept. 20 - 1892.
PLAN
Excavations Of the Burrows Of American Marmot By Wm Hubbell Fisher Cincinnati O USA
SANDY
LOAM
INDURATED CLAY (HARD PAN)
WHITE
SAND
SECTION



Illustrations of how marmot closes his burrow when latter is cut open in vertical section.

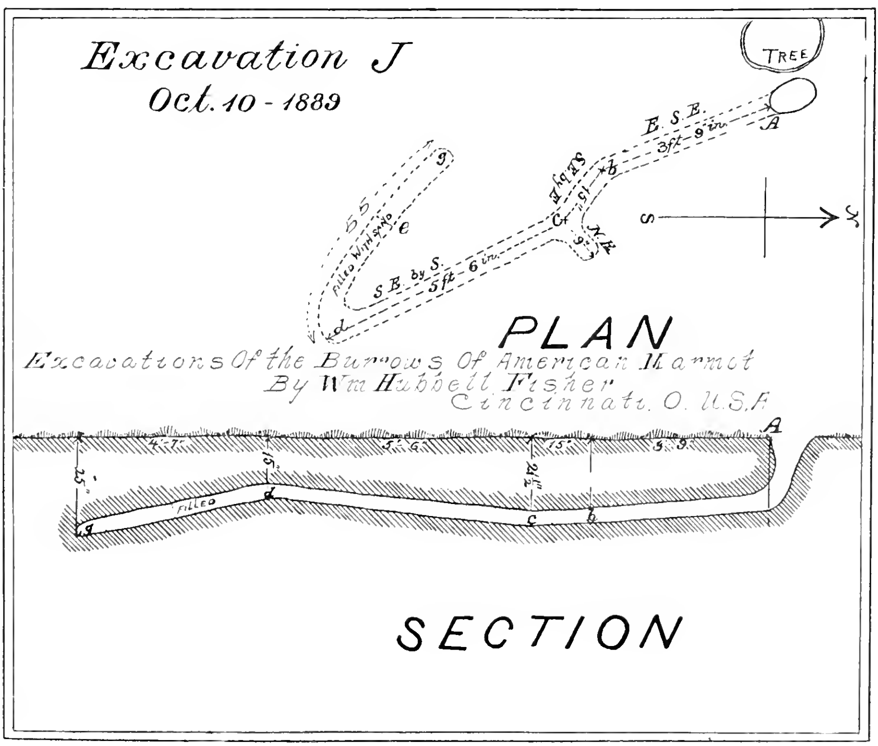
Plate 2 showing burrow partially closed by marmot

Excavation of the burrows of American marmot by Wm Hubbell Fisher Cincinnati O U S A.

Plate 3 showing burrow entirely closed by marmot

Plate 1 showing burrow open

Excavation of the burrows of American marmot by Wm Hubbell Fisher Cincinnati O U. S. A.



THE JOURNAL

OF THE

Cincinnati Society of Natural History.

VOL. XVI. CINCINNATI, JANUARY, 1894. NO. 4.

PROCEEDINGS.

December 5, 1893.

The regular December meeting of the Society was called to order at 9.32 P. M., with President Collier in the Chair, after the members and guests had listened to a very interesting discourse by Prof. Eadweard Muybridge, of the University of Pennsylvania, upon the "Human Body in Action," illustrated by numerous lantern slides.

The minutes of May 2 were read and approved.

The following applications for membership were read and ordered posted, to-wit: F. B. Magill, F. M. Coppock and F. P. Goodwin.

The following persons were elected to active membership, to-wit: T. J. Foy, Joseph Kirkup, H. L. Groesbeck, W. F. Robertson and L. R. Myres.

Upon motion, the reading of the minutes of the Executive Board, from May 2 to November 7, was dispensed with.

Messrs. Kelley, James and Norton were appointed a committee upon the death of Dr. Wm. Carson and Mr. J. Ralston Skinner.

Adjourned at 9.39.

DONATIONS.

Dr. F. W. Langdon, pamphlets, as follows: A descriptive account of the (Nottingham) Aviary and its inmates, C. L. Rothera; British Museum publications: Guide to Mammalia,

General Guide, Shell and Starfish Guide, Guide to Geology and Palæontology, I and II; Guide to Mineral Gallery, Guide to Reptiles and Fishes, Guide to Fossil Fishes, Introduction to Study of Minerals, Guide to Gardens of Zoological Society of London, Collections Botanique de Museé Royal de Physique et d'Historie Naturelle, Florence.

Mrs. Thomas Foster, Glass Covers and Globes.

Mrs. Murdock, Black Walnut Book Case.

E. O. Hurd, Mounted Specimens of Hooded Merganser (Lophodytes cucullatus) of Raven (Corvus corax) or Rough-Legged Buzzard (Archibuteo Lagopus var. Sancti-Johannis).

THE MYXOMYCETES OF THE MIAMI VALLEY, OHIO.

By A. P. Morgan.

Third Paper.

(Read February 6, 1894.)

Order VI. STEMONITACEÆ.

Sporangia globose or ovoid to oblong and cylindrical, stipitate; the wall very thin and fragile, soon disappearing. Stipe tapering upward and continued within the sporangium as a more or less elongated columella. Capillitium of slender brown threads, arising from numerous points of the columella, repeatedly branching and usually anastomosing to form a network, persistent and rigidly preserving the outline of the sporangium. Spores globose, brown or violaceous.

This order is readily distinguished by the brown persistent capillitium, arising from a lengthened columella, and rigidly maintaining the form of the sporangium.

Table of Genera of Stemonitaceæ.

A. Stipe and columella brown or black.

a. The columella scarcely reaching the center of the sporangium.

1. Clastoderma. Threads of the capillitium forking several times, but not combined into a network.

2. LAMPRODERMA. Threads of the capillitium branching and anastomosing to form a network.

b. The columella extending beyond the center of the sporangium.

3. COMATRICHA. Threads of the capillitium forming only an interior network, attaining the wall by numerous more or less elongated free extremities.

4. STEMONITIS. Threads of the capillitium forming an interior network of large meshes and a superficial network of smaller meshes.

5. ENERTHENEMA. Threads of the capillitium pendent from a discoid membrane at the apex of the columella.

B. Stipe and columella white or yellowish.

6. DIACHAEA. Threads of the capillitium branching and anastomosing to form a network.

I. CLASTODERMA, Blytt. Sporangium regular, globose, stipitate; the wall very thin and fragile. Stipe elongated, tapering upward, entering the sporangium as a very short or nearly obsolete columella. Capillitium arising by a few branches from the apex of the columella, these branches forking several times at a sharp angle, but not combined into a network, the ultimate branchlets long and free, or only connected together at their tips by persistent fragments of the sporangial wall. Spores globose, violaceous.

The claim of this genus to be distinguished from Lamproderma must rest upon the fact that the branchlets of the capillitium do not anastomose and form a network. It is the same as the genus Orthotricha of Wingate.

1. CLASTODERMA DE BARYANUM, Blytt. Sporangium very small, globose; the wall early disappearing, except the minute

fragments which persist at the extremities of the capillitium, and a narrow collar at the base of the columella. Stipe very long, thick and brown below, tapering upward to a pellucid oblong swelling, thence abruptly narrowed to the apex; the columella extremely short, capillitium of very slender pale-brown semi-pellucid threads, divergently forking, the ultimate branchlets often joined 2–4 together at their tips by fragments of the sporangial wall, Spores globose, even, violaceous, 8–9 mic. in diameter. See Plate XI, Fig. 25.

Growing in rather a scattered way on old rotten wood. Sporangium .20–.25 mm. in diameter, the stipe .7–1.3 mm. long. *Orthotricha microcephala*, Wingate. Blytt's species was found in Norway, Wingate's in Pennsylvania; I have met with it several times in this locality. It is possibly more common than it appears, as by reason of the difficulty of seeing the minute sporangium it is passed by as some mold. Blytt's spore measurements are 9.5–11 mic.; in some specimens I have seen a few spores of this size, but they are abnormal.

II. LAMPRODERMA, Rost. Sporangia regular, globose, stipitate; the wall thin and fragile, rugulose, shining with metallic tints, breaking up irregularly and gradually falling away. Stipe more or less elongated, smooth, brown or black in color, arising from a hypothallus, tapering upward and entering the sporangium as a short columella scarcely reaching the center. Capillitium of numerous threads radiating from the columella, usually forking several times and combined into a net by lateral anastomosing branchlets. Spores globose, brown or violaceous.

Lamproderma is distinguished by the shining metallic tints of the sporangial wall, and by the short columella scarcely reaching half the height of the sporangium.

1. LAMPRODERMA PHYSAROIDES, A. & S. Sporangium globose; the wall with a silvery metallic luster, at length breaking up and falling away. Stipe long, slender, brown or blackish, arising from a small circular hypothallus; columella clavate, obtuse, not reaching the center of the sporangium. Cap-

illitium of brownish-violet threads, arising from the upper part of the columella; these branch repeatedly at a sharp angle, form an intricate network of elongated meshes, terminating at the wall in numerous short free branchlets. Spores globose, minutely warted, bright brown, 12–14 mic. in diameter.

Growing on old wood, moss, etc., New York, *Chas. H. Peck.* Distinguished by the pale silvery sporangial wall and the clear brown spores.

2. LAMPRODERMA ARCYRIONEMA, Rost. Sporangium small, globose; the wall dark bronze, with a silvery sheen when loosened from the spores, soon breaking into scales and falling away. Stipe long and slender, smooth, shining and black, rising from a thin hypothallus; the columella short cylindric, variable in length, but not attaining the center of the sporangium. Capillitium arising by division of the apex of the columella into several primary branches; these immediately separate into numerous slender flexuous brown threads, which unite and form a dense network of small arcuate meshes, the ultimate branchlets not free. Spores globose, even, violaceous, 6–7 mic. in diameter. See plate XI, Fig. 26.

Growing on old wood of Juglans and Carya. Sporangium .3–.5 mm. in diameter, the stipe three or four times as long. The columella is somewhat variable, it sometimes forks or divides immediately on entering the sporangium, at other times it is longer and cylindric, with more slender primary branches. The meshes of the capillitium resemble those of Arcyria, whence the name. This is the *Stemonitis physaroides*, A. & S. var. *subæneus* of Lea's Catalogue.

3. LAMPRODERMA VIOLACEUM, Fr. Sporangium depressed-globose, convex above and more or less flattened and umbilicate beneath; the wall shining with steel or violet, blue and purple tints, deciduous. Stipe short, stout, brown or blackish in color, arising from a thin, brown, common hypothallus; columella cylindric, or tapering slightly to an obtuse apex, attaining the center of the sporangium. Capillitium of numerous slender threads, radiating from the upper part of the columella; these threads are brown below, with a vari-

able outer portion colorless; they branch a few times and form an interior network of elongated meshes, outwardly arching and freely anastomosing they give rise to an external network of small irregular meshes, they then attain the wall by innumerable short, simple, or forked free branchlets. Spores globose, minutely spinulose, violaceous, 9–11 mic. in diameter. See plate XI, Fig 27.

Growing on old wood, mosses, etc., late in Autumn. Sporangium .5–.8 mm. in diameter, the stipe about the same length. The capillitium is sometimes most of it colorless and flaccid; sometimes it is all brown and rigid except the minute free extremities.

4. LAMPRODERMA ARCYRIOIDES, Somm. Sporangium globose or ellipsoid, and somewhat elongated; the wall with tints of violet, purple, and blue, deciduous. Stipe usually short, or sometimes nearly obsolete, brown or blackish in color, arising from a strongly-developed hypothallus; the columella cylindric or slightly tapering upward, and obtuse, reaching nearly to the center of the sporangium. Capillitium of numerous pale-brown threads, radiating from the apex of the columella; these fork directly from the base, are bent and flexuous, and are combined into a dense, intricate net, with abundant free extremities. Spores globose, spinulose, violaceous, 13–16 mic. in diameter.

Growing on old leaves, wood, etc. Sporangium .5–.8 mm. in diameter, the stipe variable in length from very short to 1 mm. long or beyond. *Lamproderma columbinum*, Pers. is a doubtful species, the forms of that name being easily distributed between the present species and *L. physaroides*.

5. LAMPRODERMA SCINTILLANS, B. & Br. Sporangium globose; the wall shining with colors of blue, purple, and bronze, deciduous. Stipe long, slender, smooth, and shining, brown or blackish, rising from a thin, brown, common hypothallus; columella cylindric or slightly tapering to the obtuse apex, not reaching the center of the sporangium. Capillitium of numerous brown threads, originating about the apex of the columella; these fork several times, with few anastomosing branchlets, and terminate at the wall in long, free extremities. Spores globose, minutely warted, violaceous, 7–9 mic. in diameter. See Plate XI, Fig. 28.

Growing on old leaves, moss, etc., in early Spring. Sporangium .3–.5 mm. in diameter, the stipe from once to twice as long. This is *Lamproderma irideum* of Massee's Monograph. I am indebted to Arthur Lister, Esq., of London, for the identification of my specimens with *Stermonitis scintillans*, B. & Br., and with *Lamproaerma irideum*, Cke.

III. COMATRICHA, Preuss. Sporangia various in shape, from globose or ovoid to oblong and cylindric, stipitate; the wall very thin and fugacious. Stipe more or less elongated, smooth and black, arising from a common hypothallus, tapering upward, entering the sporangium and prolonged nearly or quite to the apex as a columella. Capillitium arising from numerous points of the columella throughout its entire length; the threads immediately branching and anastomosing to form an interior network, attaining the wall by numerous more or less elongated free extremities. Spores globose, brown or violaceous.

This genus is not sharply limited from Stemonitis. The species with very short free ends, and consequently with superficial meshes approximate to the wall, are near the form of Stemonitis. But it may be observed that in these species, the meshes of the capillitium become smaller gradually outward, the sides of the superficial meshes are arched away from the wall, and they are in contact with it only by the free extremities.

§1. TYPHOIDES. Threads of the capillitium repeatedly branching and anastomosing, to form a dense network of small meshes, with innumerable short, free extremities.

1. COMATRICHA TYPHINA, Roth. Sporangia short, erect or a little curved, cylindric or usually narrowing slightly upward, the base quite blunt, the apex more rounded, growing together on a thin hypothallus. Stipe and columella brown or blackish, tapering upward and vanishing near the apex of the sporangium, the stipe much shorter than the columella. Capillitium of slender flexuous tawny-brown threads; these branch repeatedly, forming an intricate network of small irregular meshes, ending in very short free

extremities. Spores globose, violaceous, very minutely warted, 6–8 mic. in diameter.

Growing on old wood, mosses, etc. Sporangium with the stipe 2–4 mm. in height, the stipe much the shorter, the sporangium .35–.40 mm. in thickness. *Stemonitis typhoides*, Fries, S. M.

2. COMATRICHA ÆQUALIS, Pk. Sporangia usually more or less inclined or curved and nodding, cylindric, obtuse at each end, growing together on a thin hypothallus. Stipe and columella slender, smooth, black, extending nearly or quite to the apex of the sporangium, the stipe longer than the columella. Capillitium of very slender flexuous tawny-brown threads; these branch repeatedly, forming an intricate network of small irregular meshes, ending in very short free extremities. Spores globose, minutely warted, dark violaceous, 7–9 mic. in diameter.

Growing on old wood. Sporangium 1.5–3 mm. in height by .35–.40 mm. in thickness, the stipe usually about the same length as the sporangium, but sometimes nearly twice as long. The capillitium is rather looser than in *C. typhina*, whence the drooping habit. Peck, Thirty-first Report, p. 42.

3. COMATRICHA NIGRA, Pers. Sporangia globose or ovoid to ellipsoid or oblong, erect or sometimes inclined or even nodding. The stipe very long, smooth and black, tapering upward, expanding at the base into a small circular hypothallus; the columella short, reaching from one-half to three-fourths the height of the sporangium. Capillitium of slender flexuous brown threads, which branch repeatedly, forming a dense intricate network of small meshes, ending in very short free extremities. Spores globose, even, dark violaceous, 8–10 mic. in diameter.

Growing on old wood, leaves, etc. Sporangium .5–1.5 mm. in height, .5–.8 mm. in diameter, the stipe 1.5–3 mm. long or sometimes considerably longer. This species seems to be rare in this country. I have preferred the name adopted by Schroeter to Rostafinski's *Comatricha Friesiana*.

4. COMATRICHA ELLISII, Morgan, n. sp. Sporangia short, erect, oval or ovoid to oblong. Stipe and columella erect, brown and smooth, rising from a thin pallid hypothallus,

tapering upward and vanishing into the capillitium toward the apex of the sporangium, the stipe usually longer than the columella. Capillitium of slender pale brown threads; these branch several times with lateral anastomosing branchlets, forming a rather open network of small meshes, ending with very short free extremities. Spores globose, even, pale ochraceous, 6–7 mic. in diameter. See Plate XI, Fig. 29.

Growing on old pine wood. Sporangium .3–.6 mm. in height by .3–.5 mm. in width, the stipe usually a little longer than the sporangium. This elegant little species I have from Mr. J. B. Ellis, of Newfield, N. J. It is said to be mingled in some of the specimens with *Lamproderma Ellisiana*, Cke.

§2. LARVELLA. Threads of the capillitium branching a few times and anastomosing to form a network of large meshes, attaining the wall by numerous long, free extremities.

5. COMATRICHA CRYPTA, Schw. Sporangia cylindric, bent or flexuous and more or less inclined, growing close together on a conspicuous purplish-brown hypothallus. Stipe and columella smooth and black, tapering upward and reaching the apex of the sporangium, the columella bent and flexuous or spirally twisted, about as long as the stipe. Capillitium composed of irregular, bent and uneven threads, which are brown below, becoming colorless outwardly; the threads branch a few times, forming a network of large irregular meshes, sometimes much defective; the free extremities irregular and unequal, simple or branched. Spores globose, brown, minutely warted, 7–9 mic. in diameter. See Plate XI, Fig. 30.

Growing out of fissures of the bark and wood of Hickory, Acer, etc. Sporangium with the stipe 4–7 mm. in height, the stipe a little shorter, or sometimes much longer than the sporangium, the latter .25–.30 mm. in thickness. The exterior colorless portion of the capillitium is exceedingly delicate, easily breaking away and leaving the capillitium quite irregular and defective. *Stemonitis crypta*, Schweinitz's N. A. Fungi, 2351. *Comatricha irregularis*, Rex, is the same thing.

6. COMATRICHA CÆSPITOSA, Sturgis. Sporangia short, clavate, densely crowded or cæspitose upon a delicate hypothallus; the wall subpersistent, silvery, shining with tints of

purple and blue. Stipe very short or nearly obsolete, the columella rising to two-thirds or three-fourths the height of the sporangium. Capillitium of slender dark-brown threads, which branch and anastomose quite irregularly, forming a network of intermingled large and small meshes, ending in long, tapering, free extremities. Spores globose, minutely spinulose, dark violaceous, 10–12 mic. in diameter.

Growing on moss and lichens, at Wood's Holl, Massachusetts. Sporangium 1–1.5 mm. in height, the stipe very short or sometimes apparently wanting. I am indebted to Dr. W. C. Sturgis, of New Haven, Conn., for a specimen of this unique species.

7. COMATRICHA LONGA, Peck. Sporangia very slender and much elongated, tapering gradually upward, weak and prostrate or pendulous, growing close together on a well-developed purplish-black hypothallus. Stipe and columella capillary, smooth and black, reaching to the apex of the sporangium or often vanishing in the network far below it, the stipe very short, the columella long and flexible. Capillitium of long, slender, dark-brown threads; these are reticulately connected near the base, forming a network of large irregular meshes in a series along the columella; outwardly they are terminated by very long free branchlets, which vary from simple to two or three times forked or branched. Spores globose, minutely warted, dark brown, 8–10 mic. in diameter. See Plate XI, Fig. 31.

Growing on old wood and bark of Elm, Willow, etc., in Autumn. Sporangium with the stipe 15–40 mm. in length, the stipe 3–8 mm. long, the sporangium .25–.40 mm. in thickness. This is the most characteristic species of the genus, being farthest removed from Stemonitis.

8. COMATRICHA FLACCIDA, Lister. Sporangia growing closely crowded together and more or less confluent, on a purplish-brown hypothallus, the walls fugacious. Columellas rising simply from the common hypothallus, or sometimes grown together below and then apparently branching, running through to the apex, and there often confluent with each other, or joined together by portions of membrane. Capillitium of slender brown threads, which branch and anasto-

mose very irregularly, forming a ragged network with large irregular meshes, and long free extremities; the capillitium of adjoining columellas being much entangled, and often confluent or grown together. Spores globose, very minutely warted, brown, 7–9 mic. in diameter.

Growing on old wood and bark of Oak, Willow, etc. The component sporangia 5–10 mm. in length. The early appearance is much like that of species of Stemonitis, but the mature stage is a great mass of spores with scanty capillitium, as in Reticularia; the columellas, however, are genuine and not adjacent portions of wall grown together. Arthur Lister calls this *Stemonitis splendens*, var. *flaccida*.

IV. STEMONITIS, Gled. Sporangia subcylindric, elongated, stipitate, standing close together on a well-developed common hypothallus, the wall very thin and evanescent. Stipe brown or black, smooth and shining, tapering upward, entering the sporangium and prolonged nearly to the apex as a slender columella, the stipe shorter than the columella. Capillitium arising from numerous points of the columella throughout its entire length; the threads immediately branch and anastomose to form an interior network of large meshes, they then spread out next the wall of the sporangium into a superficial network of smaller meshes. Spores globose, brown or violaceous.

In this genus there are two distinctly differentiated series in the capillitium, the one an interior supporting network of large meshes, the other a superficial network of smaller meshes; sometimes the superficial network disappears or is wanting toward the upper part of the capillitium, there is then an approach to Comatricha. Very minute scattered branchlets usually connect the superficial network with the wall of the sporangium.

§1. DICTYNNA. Threads of the capillitium arising from numerous points of the columella, immediately branching several times and anastomosing to form the interior network of large meshes; the superficial network consisting of small irregular and unequal meshes, varying from smaller than the spores to two or three times their diameter.

1. STEMONITIS FUSCA, Roth. Sporangia elongated, subcylindric, tapering and obtuse at the apex, tapering gradually downward, growing closely crowded together on a strongly-developed brown hypothallus. Stipe and columella smooth and black, tapering gradually upward and disappearing near the apex of the sporangium, the stipe shorter than the columella. Capillitium of slender brown or blackish threads, which immediately branch and anastomose, forming a dense interior network of large irregular meshes, the ultimate branchlets of which support a superficial network of small polygonal meshes. Spores globose, dark violaceous, the surface minutely warted, the warts with a reticulate arrangement, 7–9 mic. in diameter.

Growing on old wood, bark, leaves, etc.; common everywhere. Sporangium with the stipe 6–15 mm. in height, the sporangium .3–.4 mm. in thickness, the stipe variable in length, but always shorter than the sporangium. The meshes of the superficial net vary in size in the same sporangium, being usually 5–25 mic. in width, but sometimes they are larger, ranging from 10–40 mic. in extent. The name *Stemonitis maxima* was given by Schweinitz to some unusually large specimens which grew on a Polyporus. *Stemonitis dictyospora* of Rostafinski's monograph, with spores 12 mic. in diameter, is said to occur in South Carolina; I have seen no specimens.

2. STEMONITIS TENERRIMA, B. & C. Sporangia small, subcylindric, tapering and obtuse at the apex, tapering gradually downward, growing close together on a thin brown hypothallus. Stipe and columella black and smooth, tapering gradually upward and vanishing toward the apex of the sporangium, the stipe shorter than the columella. Capillitium of very slender pale violet threads, which branch and anastomose to form a dense interior network of large irregular meshes, and then spread out into a superficial network of small polygonal meshes. Spores globose, even, pale brownish-violet, 6–8 mic. in diameter. See Plate XI, Fig. 32.

Growing on old wood mosses, etc. Sporangium with the stipe 5–9 mm. in height, the sporangium .2–.3 mm. in thickness, the stipe variable in length, but always shorter than the sporangium. The meshes of the superficial network varying

usually from 3–15 mic. in width, but sometimes larger from 8–25 mic. The species grows scantily in this region, but I have elegant specimens from Alabama, sent me by Prof. Geo. F. Atkinson.

3. STEMONITIS MICROSPORA, Lister. Plasmodium white Sporangia elongated, subcylindric, tapering and obtuse at the apex, tapering gradually downward, growing closely crowded together on a strongly-developed brown hypothallus. Stipe and columella brown and smooth, tapering gradually upward and reaching nearly to the apex of the sporangium, the stipe shorter than the columella. Capillitium of slender tawny-brown threads; the primary branches simple or only branched above, or with a few lateral anastomosing branchlets, forming a rather loose network of large irregular meshes; these support a superficial network of very small polygonal meshes. Spores globose, even, tawny-brown, 5–6 mic. in diameter.

Growing on old wood, bark, leaves, etc.; very common in this region. Sporangium with the stipe 7–15 mm. in height, the sporangium .3–.4 mm. in thickness, the stipe shorter than the sporangium. Meshes of the superficial network 4–20 mic. in width. I am indebted to Arthur Lister, Esq., of London, for pointing out to me the difference between this species and the *Stemonitis ferruginea* of Fries and Rostafinski.

4. STEMONITIS FERRUGINEA, Ehr. Plasmodium lemon-yellow. Sporangia subcylindric, the apex obtuse, growing closely crowded together on a thin, brown hypothallus. Stipe and columella brown and smooth, tapering gradually upwardand vanishing beneath the apex of the sporangium, the stipe much shorter than the columella. Capillitium of slender, tawny-brown threads, which immediately branch and anastomose, forming a dense interior network of large irregular meshes, supporting a superficial network of small polygonal meshes. Spores globose, very minutely warted, tawny-brown in color, 7–9 mic. in diameter.

Growing on old wood, leaves, grasses, etc. Sporangium with the stipe 4–10 mm. in height, the sporangium .3–.4 mm. in thickness, the stipe much shorter than the sporangium. The meshes of the superficial network varying from 6–30 mic. or sometimes from 10–40 mic. in width, according to the

specimen. The species is certainly rare in this country, and my description is drawn up from British specimens. But I am unable to distinguish authentic specimens of *Stemonitis herbatica*, Peck, from these British specimens.

§ 2. MEGALODICTYS. Threads of the capillitium arising from rather distant points of the columella, branching and anastomosing but a few times, thus forming an interior network of very large meshes; the superficial network consisting of large irregular meshes, varying from three or four to many times the diameter of the spores.

5. STEMONITIS WEBBERI, Rex. Sporangia subcylindric, the apex obtuse, tapering gradually downward, growing close together on a common hypothallus. Stipe and columella black and smooth, the stipe very short, the columella extending nearly or quite to the apex of the sporangium, the upper part usually flexuous. Capillitium composed of slender, flexuous brown threads; these immediately branch and anastomose several times, forming an interior network of very large meshes; the superficial network consisting of large irregular meshes, sometimes much elongated. Spores globose, very minutely warted, brown, 7–9 mic. in diameter. See Plate XI, Fig. 34.

Growing on old wood, bark, etc. Sporangium with the stipe 5–10 mm. in height, the stipe 1–2 mm. in length, the sporangium .3–.4 mm. in thickness; meshes of the superficial net of the capillitium 40–100–150 mic. in extent. This is a much smaller species than *Stemonitis splendens*, and the structure of the interior network of the capillitium is entirely different.

6. STEMONITIS SPLENDENS, Rost. Sporangia linear-cylindric, obtuse at the apex, growing close together on a conspicuous hypothallus. Stipe and columella black and shining, the stipe very short, the columella reaching nearly or quite to the apex of the sporangium, often flexuous above. Capillitium composed of brown threads, variable in thickness, often with membranaceous expansions; the primary branches some of them simple or only branched above, others with a few anastomosing branchlets, forming an interior network of extremely large meshes; the superficial network consisting

of large, irregular, roundish or polygonal meshes. Spores globose, very minutely warted, brown, 7–9 mic. in diameter. See Plate XI, Fig. 33.

Growing on old wood. Sporangium with the stipe 15–25 mm. in height, the stipe 4–6 mm. in length, the sporangium about .4 mm. in thickness; the meshes of the superficial network of the capillitium 25–50–80 mic. or sometimes as much as 100 mic. in extent. This is *Stemonitis Morgani*, Peck.

V. ENERTHENEMA, Bowm. Sporangium regular, globose, stipitate; the wall thin and fragile, fugacious. Stipe stout, thick, tapering upward, entering the sporangium and prolonged to its apex, there expanding into a discoid membrane. Capillitium originating from the lower surface of the apical disk of the columella; the threads branched a few times and hanging downward, their extremities free. Spores globose, violaceous.

A well-marked genus, by reason of the peculiar origin of the capillitium.

1. ENERTHENEMA PAPILLATUM, Pers. Sporangium globose, stipitate; the wall brown or blackish, soon disappearing. Stipe black, rugulose, thick below, tapering above into the slender columella, which, at its apex, expands into a thin membranaceous disk. Capillitium of long brown threads suspended from the apical disk, the threads branched a few times, occasionally anastomosing by a short, transverse branchlet, the free ends often forked. Spores globose, very minutely warted, violaceous, 10–12 mic. in diameter. See Plate XI, Fig. 35.

Growing on old wood. Stipe and columella .8–1.2 mm. in height. The species seems to be rare in this country, as I have met with it but once myself, and have received only a few specimens from elsewhere.

VI. DIACHÆA, Fr. Sporangia globose to oblong, stipitate, arising from a common hypothallus; the wall thin, rugulose, iridescent with metallic tints, breaking up irregularly and

gradually falling away. Stipe and columella thick, erect, rigid, tapering upward, filled with minute, roundish granules of lime, white or yellowish in color. Capillitium arising from numerous points of the columella, the threads repeatedly branching and anastomosing to form an intricate network, attaining the wall by numerous short free extremities. Spores globose, violaceous.

This genus is scarcely to be distinguished from Lamproderma, except by the white mass of lime which fills the tube of the stipe and columella.

1. Diachæa leucopoda, Bull. Sporangia ovoid-oblong to short cylindric, the base obtuse or slightly umbilicate, the apex more rounded; the wall with bronze, blue, purple, and violet tints, gradually falling away. Stipe short, thick, white, arising from a white, venulose, hypothallus, tapering upward; the columella cylindric or slightly tapering, obtuse, terminating below the apex of the sporangium. Capillitium of slender, flexuous brown threads forming a dense network of rather small meshes. Spores globose, very minutely warted, violaceous, 7–9 mic. in diameter.

Growing on old leaves, sticks, etc., and sometimes running over living plants. Sporangium with the stipe 1–2 mm. in height, the stipe usually much shorter than the sporangium, the latter .4–.5 mm. in thickness. *Diachæa elegans*, Fr.

2. Diachæa splendens, Peck. Sporangia globose, sometimes a little depressed, with the base umbilicate; the wall steel-blue with tints of purple and violet, quite persistent, rupturing irregularly. Stipe short, thick, white, arising from a white, reticulate hypothallus, tapering upward; the columella oblong or short cylindric, extending beyond the center of the sporangium. Capillitium of slender, brown threads, which branch several times and form a loose network of rather large meshes. Spores subglobose, with very large warts, dark violet, 8–10 mic. in diameter.

Growing on old leaves and twigs. Sporangium .4–.6 mm. in diameter, the stipe about the same length. This is a beautiful species.

3. Diachæa Thomasii, Rex. Sporangia globose, or sometimes a little depressed; the wall gold-bronze, with tints of

purple and blue, subpersistent, rupturing irregularly. Stipe thick, dull ochre-yellow in color, variable in length, usually very short and sometimes quite obsolete, arising from an ochre-yellow hypothallus; the columella varying from bluntly-conical to cylindric-clavate, attaining the center of the sporangium. Capillitium of slender, brown threads, radiating from all points of the columella, branching several times and forming a loose network of elongated meshes. Spores globose, minutely warted, violaceous, 11–12 mic. in diameter. See Plate XI, Fig. 36.

Growing on sticks, leaves, etc. Sporangium .5–.7 mm. in diameter, the stipe usually shorter or sometimes wanting. This species has been found only in the mountains of North Carolina. I am indebted to Dr. George A. Rex for my example. In its structure the species is essentially a Lamproderma, but the stipe and columella are stuffed with granules of lime.

ORDER VII.—DIDYMIACEÆ.

Sporangia simple and subglobose, or plasmodiocarp, rarely combined into an æthalium. Wall of the sporangium a thin membrane with an outer layer composed of minute stellate crystals, or of minute roundish granules of lime; these either lie singly upon the surface, or are compacted into a crustaceous coat. Stipe present or often wanting; the columella usually conspicuous and well-developed. Capillitium consisting of very slender, often sinuous threads, which extend from the base of the sporangium or from the columella to the walls, either simple or outwardly branching a few times at a sharp angle, combined into a loose irregular net by a few transverse branchlets, which are situated chiefly at the extremities. Spores globose, violaceous.

This order is readily distinguished from the Physaraceæ by the absence of lime from the threads of the capillitium.

Table of Genera of Didymiaceæ.

a. The lime on the wall of the sporangium in the form of minute stellate crystals.

1. Didymium. Sporangium simple, subglobose and stipitate, the base commonly umbilicate, or sometimes sessile and plasmodiocarp.

2. Spumaria. Æthalium composed of numerous elongated irregularly-branched sporangia, closely compacted together and confluent.

b. The lime on the wall of the sporangium consisting of minute roundish granules.

3. Diderma. Wall of the sporangium with the outer calcareous layer usually compacted into a smooth continuous crust.

4. Lepidoderma. Wall of the sporangium with an outer layer of large scales, consisting of bicarbonate of lime.

I. DIDYMIUM, Schrad. Sporangium simple, subglobose and stipitate, the base commonly umbilicate, or sometimes sessile and plasmodiocarp; the wall a thin membrane with an outer layer of minute stellate crystals of lime. Stipe present or sometimes wanting; the columella mostly conspicuous, sometimes thin or obsolete. Capillitium of very slender threads, straight or often sinuous, stretching from the columella to the wall of the sporangium, simple or outwardly sparingly branched at a sharp angle. Spores globose, violaceous.

Didymium, together with Spumaria, is to be distinguished from all other genera of the Myxomycetes by the covering of stellate crystals, like hoar-frost, upon the outer surface of the sporangium.

§ 1. CIONIUM. Columella prominent, subcentral, globose, obovoid, or turbinate; the threads of the capillitium radiating in all directions to the wall of the sporangium.

A. Sporangium stipitate.

1. DIDYMIUM SQUAMULOSUM, A. & S. Sporangium variable in form and size, small and globose, or large and much depressed, the base usually umbilicate, stipitate, or sometimes sessile, and even plasmodiocarp; the wall very thin and pellucid, with a thin, gray-white layer of stellate crystals of lime, breaking up into subpersistent scales. Stipe short, erect, snow-white, longitudinally furrowed or plicate; the columella central. snow-white, various in shape, globose, obovoid, turbinate, and stipitate or sessile. Capillitium of numerous colorless threads, radiating from the columella and separating outwardly into several branches. Spores globose, very minutely warted, dark violaceous, 8–10 mic. in diameter.

Growing on old wood, leaves, herbaceous stems, etc. Sporangium .4–.6–.8 mm. in diameter, the stipe scarcely longer than the diameter, often much shorter or nearly wanting.

2. DIDYMIUM PROXIMUM, B. & C. Sporangium globose or depressed-globose, the base more or less umbilicate, stipitate; the wall very thin and pellucid, with a loose white covering of stellate crystals of lime, the upper part breaking up and falling away. Stipe long, erect, tapering upward, yellow-brown to reddish-brown, expanding at the base into a small hypothallus; the columella central, white, turbinate, or discoid turbinate. Capillitium of slender, colorless threads, radiating from the columella, branching and often anastomosing. Spores globose, even, pale violaceous, 8–10 mic. in diameter. Plate XII, Fig. 37.

Growing on old leaves, sticks, culms, etc. Sporangium .4–.6 mm. in diameter, the stipe two or three times the diameter.

3. DIDYMIUM EXIMIUM, Peck. Sporangium depressed-globose, the base umbilicate, sometimes very much depressed and also umbilicate above, stipitate; the wall pale ocher or pale yellow, with a thin layer of minute white crystals of

lime, the upper part gradually breaking away. Stipe long, erect, tapering upward, pale yellow-brown, darker below, expanding into a small brown hypothallus; the columella central, large, discoid, or sometimes rough and irregular, pale ochre or yellowish. Capillitium of much-branched colorless threads, radiating upward and downward from the columella. Spores globose, very minutely warted, dark violaceous, 9–11 mic. in diameter. Plate VII, Fig. 38.

Growing on old leaves, sticks, etc. Sporangium .5–.6 mm. in diameter, the stipe about twice the diameter.

4. Didymium microcarpum, Fr. Sporangium small, globose, the base slightly umbilicate, stipitate; the wall a dark-colored membrane, covered with abundant snow-white crystals of lime. Stipe long, slender, erect, delicately striate, yellow-brown to blackish in color, expanded at the base into a small hypothallus; the columella small, globose, sessile or substipitate, pale yellow-brown. Capillitium of pale brown threads, somewhat branched and forming a loose net. Spores globose, very minutely warted, violaceous, 6–7 mic. in diameter.

Growing on old wood, leaves, mosses, etc. Sporangium .4–.5 mm. in diameter, the stipe two or three times as long. The species is more particularly distinguished by its small spores.

5. Didymium minus, Lister. Sporangium depressed-globose, the base umbilicate, stipitate, rarely sessile and plasmodiocarp; the wall a dark-colored membrane with a thin layer of stellate crystals of lime, breaking up gradually and falling away. Stipe erect or sometimes bent at the apex, variable in length, rarely wanting, from pale brown to blackish in color, rising from a small hypothallus; the columella reaching the center, brown or blackish, rough, convex, subglobose or pulvinate, substipitate. Capillitium of slender colorless threads, radiating from the columella and more or less branched outwardly. Spores globose, very minutely warted, violaceous, 8–10 mic. in diameter. Plate VII, Fig. 39.

Growing in vast abundance in Spring on old leaves, bark, wood, etc. Sporangium .4–.6 mm. in diameter, the stipe scarcely longer but usually shorter than the diameter of the

sporangium rarely absent. It is considered by Lister to be a variety of *D. farinaceum;* it differs from this species in its smaller and less-depressed sporangium and in its smaller nearly smooth spores.

B. Sporangia sessile.

6. Didymium effusum, Link. Sporangia gregarious or scattered, sessile on a flattened base, convex above, various in shape, subrotund or by confluence effused and venosely creeping; the wall very thin and pellucid, invested with a thin flocculose layer of minute crystals of lime. The columella hemispheric, rugulose, usually snow-white. Capillitium of very slender colorless threads, furnished with numerous minute protuberances, much branched and combined into a dense net. Spores globose, very minutely warted, dark violaceous, 10–11 mic. in diameter.

Growing on old leaves, wood, etc. Sporangium about .5 mm. in diameter or thickness, sometimes confluent and more or less elongated as a plasmodiocarp. This species is reported from the United States, but I have seen no specimens.

7. Didymium physaroides, Pers. Sporangia roundish or hemispheric, more or less irregular and deformed, sessile or with a very short stipe, and closely crowded together upon a strongly-developed common hypothallus; the wall a dark colored membrane, with a thin layer of stellate crystals of lime. The columella large and thick, divided into cells which are filled with irregular lumps of lime, common to all the sporangia. Capillitium of stout threads, usually simple, only rarely branched, furnished with numerous fusiform swellings. Spores globose, minutely warted, dark violaceous, 12–14 mic. in diameter.

Growing on old wood, bark, moss, etc. Reported from Carolina by Curtis. It is said superficially to resemble somewhat *Physarum didermoides.*

§2. Placentia. Columella basal, much depressed, very thin or quite obsolete, connate with the base of the sporangium; the threads of the capillitium ascending to the wall of the sporangium.

A. Sporangium stipitate.

8. DIDYMIUM FARINACEUM, Schrad. Sporangium hemispherical, more or less depressed, the base profoundly umbilicate; the wall firm, rugulose, dark-colored and nearly opaque, with a mealy coat of stellate crystals of lime, rupturing irregularly. Stipe variable in length, rigid, erect, black or sometimes rusty-brown, arising from a small hypothallus; the columella broad, hemispherical or pulvinate, black, the lower side connate with the wall of the sporangium. Capillitium of dark-colored sinuous threads, simple or scarcely branched. Spores globose, dark violaceous, minutely warted, 10–13 mic. in diameter. Plate XII, Fig. 40.

Growing on old wood, leaves, mosses, etc. Sporangium .6–.9 mm. in diameter, the stipe about as long as the diameter of the sporangium or sometimes much longer, usually, however, much shorter than the diameter and almost concealed within the umbilicus. My specimens are from Pennsylvania and Alabama. It is readily distinguished from *Didymium minus* by the much larger and more distinctly warted spores.

9. DIDYMIUM CLAVUS, A. & S. Sporangium pileate, very much depressed, convex above and concave below, stipitate; the wall a dark-colored membrane, thickly covered with minute white crystals of lime, except the brown concavity underneath, the upper part breaking away, the lower persistent. Stipe short, erect, rugulose, brown or blackish, expanding at the base into a small hypothallus; the columella reduced to a thin layer of minute brown scales upon the base of the sporangium. Capillitium of simple or sparingly-branched threads, colorless at the extremities and dark-colored between. Spores globose, even, violaceous, 6–8 mic. in diameter.

Growing on old leaves, sticks, herbaceous stems, etc. The sporangium .6–.8 mm. in diameter, the stipe about the same length. Fries considered this to be a mere variety of *D. farinaceum*, but it is readily distinguished by its very small spores.

B. Sporangia sessile.

10. DIDYMIUM SERPULA, Fr. Plasmodium yellow. Plasmodiocarp much depressed, subrotund or usually more or less

elongated, bent, flexuous and reticulate; the wall dark-colored, with a thin layer of stellate crystals of lime. Columella entirely wanting. Capillitium of very slender threads, extending from base to upper surface, much branched, the branches combined into a dense network; to these threads adhere numerous roundish vesicles, composed of a brownish membrane, inclosing a yellow coloring matter, the vesicles 30–50 mic. in diameter. Spores globose, very minutely warted, violaceous, 7–8 mic. in diameter.

Growing on old leaves, bark, etc. The plasmodiocarp .6–.8 mm. in thickness and extending from one to several millimeters in length. This species is reported from the United States by Massee. It ought to be readily recognized by its yellow plasmodium and the peculiar vesicles adherent to the capillitium.

11. Didymium anellus, Morgan, n. sp. Plasmodiocarp in small rings or links, then confluent and elongated, irregularly connected together, bent and flexuous, resting on a thin venulose hypothallus; the wall firm, dark-colored, with a thin layer of stellate crystals of lime, irregularly ruptured. Columella merely a thin layer of brown scales. Capillitium of slender dark-colored threads, which extend from base to wall, more or less branched, and combined into a loose net. Spores globose, very minutely warted, violaceous, 8–9 mic. in diameter. Plate XII, Fig. 41.

Growing on old leaves in woods in Spring. Plasmodiocarp in rings .3–.5 mm. in diameter, or often more or less elongated into links and chains, which are bent and flexed in quite an irregular manner, the thread or vein composing them about .2 mm. in thickness. A more minute species than *Didymium serpula*, without characteristic thickenings upon the threads of the capillitium, and wanting the peculiar large cells of this species.

II. SPUMARIA, Pers. Æthalium composed of numerous elongated, irregularly-branched sporangia, more or less closely compacted together and confluent, seated upon a well-developed common hypothallus; the walls of the sporangia

a thin membrane with an outer layer of minute, stellate crystals of lime. Each sporangium traversed by a central subcylindric hollow columella, which extends also to the branches, but does not reach to their apices. Capillitium of slender threads, more or less branched, and combined into a network. Spores globose, violaceous.

Spumaria is essentially related to Didymium by the crystals of lime upon the walls of the sporangia. Rostafinski's figure 158 can only be regarded as ideal or diagrammatic. I am disposed to question the existence of the central columella altogether; if it does exist, it must be extremely defective.

1. SPUMARIA ALBA, Bull. Plasmodium white, amplectant. Æthalium variable in form and size, resting upon a white, membranaceous hypothallus, and usually covered by a white, friable, common cortex composed of minute crystals of lime. The component sporangia elongated, irregular, more or less branched, the branches rude, deformed, compressed, laterally confluent, obtuse or pointed at the apex; the walls of the sporangia thin and delicate, rugulose, pellucid, with a tinge of violet, iridescent when divested of the crystals of lime. Capillitium of slender threads, more or less branched and combined into a net; the threads dark colored, with pellucid extremities, and furnished with occasional rings or roundish swellings throughout their length. Spores globose, densely spinulose, dark violaceous, 10–14 mic. in diameter. Plate XII, Fig. 43.

Climbing up and surrounding the stems of small shrubs, herbaceous plants, culms of grasses, etc., especially those of living plants, rarely effused upon old wood, bark, leaves, etc. The æthalium from two or three to several centimeters in length, and with a radial thickness of two or three to several millimeters. The following forms or varieties have been distinguished as species at different times:

Var. 1. DIDYMIUM. Sporangia irregular, simple or lobed and branched, lifted up on narrow, flat extensions of the hypothallus, as if furnished with short white stipes; the common cortex wanting. This is *Didymium spumarioides*, Fr.; it is probably a dwarf form of the next variety. Plate XII, Fig. 42.

Var. 2. CORNUTA. Æthalium large and rugged in outline, cinerous from the scanty cortex; the sporangia loosely com-

pacted, the branches running out into numerous free-pointed extremities. Capillitium of rather thick threads, forming a dense net, with broad expansions at the angles. Spores 11–14 mic. in diameter. This is *Spumaria cornuta*, Schum. It is evidently the form so elaborately figured by Rostafinski, and which Fries says abounds in Northern Europe.

Var. 3. MUCILAGO. Æthalium large, even and uniform in outline, covered by a thick, white, common cortex; the sporangia laterally confluent and densely compacted together throughout. Capillitium of rather slender threads, forming a loose net, scarcely expanded at the angles. Spores 10–13 mic. in diameter. This is *Spumaria mucilago*, Nees, as figured by Greville in the Scottish Cryptogamic Flora. The capillitium is figured by McBride in The Myxomycetes of Iowa. This is the only form I have met with in this country.

III. DIDERMA, Pers. Sporangia subglobose and stipitate or more often sessile, sometimes plasmodiocarp; the wall a thin membrane, with an outer layer composed of minute roundish granules of lime, which are usually compacted into a smooth continuous crust. Stipe present or mostly absent; the columella usually well developed. Capillitium of very slender threads, stretching from the columella to the wall of the sporangium, more or less branched, and combined into a loose net by short lateral branchlets. Spores globose, violaceous.

This genus is easily recognized by the smooth crustaceous layer of lime on the outer surface of the sporangium; in many cases this easily shells off or breaks away. Such a coating occurs in a few species of Physarum, but here the vesicles of lime attached to the threads distinguish them. This is Chondrioderma of Rostafinski's monograph; the reason for coining a new name and entirely discarding the old one is not apparent.

§1. LEANGIUM. Sporangium usually stipitate; the wall at maturity separating from the inner mass of spores and capillitium and splitting in a stellate manner, the segments becoming reflexed.

1. Diderma radiatum, Linn. Sporangium depressed-globose, the base flattened or umbilicate, stipitate or nearly sessile; the wall smooth, whitish or pale brown, splitting from the apex downward into a few reflexed irregular segments. Stipe short, thick, erect, tapering downward, standing on a thin membranaceous hypothallus; the columella large, convex, globose or obovoid, roughened. Capillitium of slender dark-colored threads, radiating from the columella, simple or branching outwardly. Spores globose, minutely warted, dark violaceous, 8–10 mic. in diameter.

Growing on old bark and wood. Sporangium .8–1.2 mm. in diameter, the stipe shorter than the diameter, sometimes nearly obsolete. Apparently rare in this country.

2. Diderma floriforme, Bull. Sporangium globose or obovoid, stipitate, growing closely crowded together on a thin brown membranaceous hypothallus; the wall smooth, varying in color from whitish or yellowish to bright brown, splitting into irregular segments, which become reflexed and revolute. Stipe long, erect, white or yellowish to brown; the columella elongated, obovoid to clavate, roughened, colored as the stipe. Capillitium of dark-colored threads, radiating from the columella and sparingly branched. Spores globose, with minute scattered warts, dark violaceous, 9–11 mic. in diameter. Plate XII, Fig. 44.

Growing on old wood of oak, hickory, etc., late in Autumn. Sporangium .7–1.0 mm. in diameter before dehiscence, the stipe usually longer than the sporangium. The color of stipe, columella and sporangium varies from white through yellowish to brown; the spores are quite peculiar by reason of their prominent scattered warts. I do not think *Chondrioderma Lyallii*, Massee, can be maintained as a separate species.

§2. Stromnidium. Sporangia growing closely crowded together upon a thick highly-developed calcareous common hypothallus, either seated upon it or partially imbedded in its substance; the wall rupturing irregularly.

3. Diderma spumarioides, Fr. Sporangia rather small, irregularly subglobose, sessile, seated close together on a strongly-developed whitish or yellowish common hypothallus; the wall white, rugulose, covered by a dense farinaceous layer

of lime. Columella convex, roughened, white or yellowish, sometimes scarcely developed. Capillitium rather scanty, of slender colorless threads, sparingly branched, ascending from the columella. Spores globose, minutely warted, violaceous, 8–10 mic. in diameter.

Growing on old leaves, bark, moss, etc. Sporangia .4–.6 mm. in diameter, irregular and rugulose. On account of the pulverulent coat of lime on the sporangium, Massee refers the species back to Didymium, where it was placed by Fries.

4. Diderma stromateum, Link. Sporangia large, subglobose, depressed, irregular and angular from mutual pressure, closely crowded together on a thick yellowish or pinkish common hypothallus; the wall smooth and even, grayish-white or cinereous, with a thin closely connate outer layer of minute granules of lime. Columella considerably elevated or much depressed, convex, subglobose or quite irregular, white or colored, as the hypothallus, especially at the base. Capillitium of abundant colored threads, more or less branched and combined into a loose net. Spores globose, minutely warted, violaceous, 8–10 mic. in diameter.

Growing on Hickory bark. The sporangia .5–.8 mm. in diameter, the suface smooth. Rostafinski, in his Monograph, places this species as a variety of *D. spumarioides*, but in the Appendix it is separated as a species. The sporangia are quite different from those of *D. spumarioides*, but I can see no difference in the spores.

5. Diderma globosum, Pers. Sporangia subglobose, more or less irregular from mutual pressure, closely crowded together on a thick, white hypothallus, seated upon it or usually sunk into its substance at the base; the wall with a white, smooth, and polished crustaceous outer layer of lime, distinct and separable from the inner membrane, easily breaking into fragments, and falling away: the inner membrane very thin, rugulose, cinereous with granules of lime or free from them and iridescent. Columella white, small, irregular, subglobose or ellipsoidal, rarely wanting. Capillitium of slender, dark colored threads, more or less branched and combined into a loose net. Spores globose, very minutely warted, violaceous, 8–10 mic. in diameter.

Growing on old leaves. Sporangia .5–.8 mm. in diameter, the surface smooth and polished.

6. Diderma crustaceum, Peck. Sporangia subglobose, irregular from mutual pressure, closely crowded together on a thick, yellowish-white common hypothallus, and at the base confluent with its substance; the wall with a creamy white, smooth, crustaceous outer layer of lime, distinct and separable from the inner membrane, and easily breaking up and falling away; the inner membrane very thin, rugulose, cinereous and iridescent. Columella whitish or cream colored, small, irregular, subglobose or ellipsoidal, often wanting. Capillitium of slender, uneven, dark colored threads, branched and combined into a loose net. Spores globose, minutely warted, violet-black, opaque, 12–15 mic. in diameter. Plate XII, Fig. 45.

Growing on old leaves, sticks, etc. A common species in this country. Sporangia .7–1.0 mm. in diameter, the surface even but finely pulverulent rather than polished. *Chondrioderma affine*, Rost., is said to be the same species. It is readily distinguished from *D. globosum* by the much larger spores.

§3. Astrotium. Sporangia gregarious, scattered, or sometimes crowded and confluent, often much depressed, sessile, rarely stipitate; the hypothallus none or very scanty.

7. Diderma Michelii, Lib. Sporangia orbicular, very much depressed, often umbilicate above and concave underneath, stipitate or sessile, gregarious, with the margins of the sporangia sometimes confluent. The wall with a white crustaceous layer of lime, which soon ruptures around the edges, allowing the upper part to break in pieces and fall away; the inner membrane cinereous, rupturing irregularly. Stipe short, stout, erect, arising from a small, circular hypothallus, whitish or alutaceous, longitudinally rugulose, expanding at the apex, the wrinkles running out as veins on the under side of the sporangium; the columella much flattened, lenticular or discoid, alutaceous or pinkish. Capillitium of very slender, colorless threads, simple or forking a time or two, and connected by short branchlets at the extremities. Spores globose, even, violaceous, 7–9 mic. in diameter.

Growing on sticks, leaves, herbaceous stems, etc. Sporangium .8–1.2 mm. in diameter, the stipe shorter than the diameter, sometimes very short or quite obsolete.

8. Diderma testaceum, Schr. Sporangia circular or oval, much depressed, sessile, without any hypothallus, gregarious irregularly scattered, sometimes close and even confluent. The outer calcareous layer of the wall thick, smooth, crustaceous, separate and distinct from the inner membrane, white or pinkish-white to rose-red in color, gradually breaking up in pieces and falling away; the inner membrane thin, pellucid, cinereous from the adherent granules of lime, irregularly dehiscent from the apex downward. Columella hemispheric or depressed, granulose roughened, white, pinkish, or fleshy-red. Capillitium of very slender, nearly colorless threads, more or less branched. Spores globose, very minutely warted, 8–10 mic. in diameter.

Growing on old leaves, wood, mosses, etc. Very common in this country. Sporangium .6–1.0 mm. in diameter, sometimes a little irregular, especially the form growing on mosses, and occasionally confluent.

9. Diderma cinereum, Morgan, n. sp. Sporangia subglobose, more or less irregular, somewhat depressed, sessile, usually close or crowded, sometimes confluent; the hypothallus a thin membrane, pellucid or with occasional patches of lime granules, sometimes not apparent. The wall very thin, even or rugulose, cinereous, the thin membrane covered by a single layer of closely-adherent granules of lime, rupturing irregularly. Columella white, hemispheric or depressed and irregular, the surface granulose. Capillitium of very slender, colored threads, the extremities pellucid, more or less branched. Spores globose, minutely warted, violaceous, 9–11 mic. in diameter. Plate XII, Fig. 46.

Growing on old wood, leaves, etc. The sporangium .3–.5 mm. in diameter, thin and smooth or rugulose. The species superficially greatly resembles *Physarum cinereum*.

10. Diderma difforme, Pers. Plasmodiocarp roundish, oblong, or more or less elongated and flexuous, scattered or seriately disposed; the hypothallus a thin brownish membrane, or commonly not apparent. The outer calcareous

layer of the wall snow-white, thin, smooth, distinct from the inner membrane, breaking into pieces and falling away; the inner membrane thin, opaque and bluish or pellucid and iridescent. Columella reduced to a thin layer of scales and granules upon the brownish basal membrane. Capillitium scanty, consisting of short nearly colorless threads, which are simple, or fork a time or two. Spores globose, even, dark violaceous, 10–13 mic. in diameter.

Growing on bark, leaves, twigs, herbaceous stems, etc. Plasmodiocarp .3–.5 mm. in thickness and variable in length, sometimes elongated several millimeters.

11. DIDERMA RETICULATUM, Rost. Plasmodiocarp very much depressed, roundish, oblong, much elongated and flexuous, closely crowded together and confluent; the hypothallus a thin white granulose layer of lime, scarcely broader than the plasmodiocarp. The outer calcareous layer of the wall white, distinct, very fragile and easily shelling off; the inner membrane much shrunken and withdrawn from the outer coat, rugulose, cinereous, with a dense closely-adherent layer of granules of lime. The columella a thin alutaceous, granulose-roughened layer, extending along the base of the plasmodiocarp. Capillitium of threads short and very slender, colorless, somewhat branched. Spores globose, even, pale violaceous, 6–8 mic. in diameter. Plate XII, Fig. 47.

Growing on old wood, leaves, twigs, etc. Plasmodiocarp .5–.8 mm. in width, much flattened and usually closely crowded. The rough calcareous base of the plasmodiocarp might be considered as either all columella or all hypothallus, with the upper surface leather-colored. I am indebted to Arthur Lister, of London, for the determinatlon of my specimens.

12. DIDERMA EFFUSUM, Schw. Plasmodiocarp very much flattened, longitudinally creeping and reticulate or altogether widely effused; hypothallus none. The wall very thin, smooth, white or cinereous, the thin membrane covered by a single layer of closely-adherent granules of lime, rupturing irregularly. The columella reduced to a thin alutaceous layer of granules of lime, forming the base of the plasmodiocarp. Capillitium of short colorless threads, extending from base to

wall, the extremities branched and connected together. Spores globose, even, pale violaceous, 8–10 mic. in diameter. Plate XII, Fig. 48.

Growing on old leaves. The plasmodiocarp forms very much flattened irregular patches from a few to several millimeters in length or extent. I am indebted to Dr. Geo. A. Rex, of Philadelphia, for the identification of my specimens, with those in the herbarium of Schweinitz, under the name of *Physarum effusum*.

IV. LEPIDODERMA, DeB. Sporangium stipitate or sessile, sometimes plasmodiocarp; the wall a thin, firm, colorless membrane, with an outer layer of large scales consisting of bicarbonate of lime, the scales either lying upon the wall or inclosed in lenticular cavities of the membrane. Stipe present or absent; the columella usually conspicuous. Capillitium of very slender threads, simple or outwardly branching at a sharp angle, connected at the extremities. Spores globose, violaceous.

"In the present genus the carbonate of lime is present in the form of very minute amorphous lumps until near to maturity, when it is dissolved and reappears as bicarbonate of lime deposited in comparatively large flakes."—*Massee.*

1. LEPIDODERMA TIGRINUM, Schr. Sporangium large, much depressed, hemispheric or lenticular, the base umbilicate, stipitate; the wall a firm, dark colored membrane, variegated with large and small irregular shining scales, greenish-yellow or straw color, rupturing irregularly. Stipe stout, thick, erect, rugulose, ochraceous or ferruginous, variable in length, expanding at the base into a thin hypothallus; the columella brown, convex or hemispheric. Capillitium of slender, dark colored threads, simple or sparingly branched, radiating from the columella to the wall. Spores globose, minutely warted, dark violaceous, 10–13 mic. in diameter.

Growing on old wood, moss, etc. Sporangium 1–1.5 mm. in diameter, the stipe 1 mm. or less in length. This appears to be the only species of the genus thus far discovered in this country.

MINERAL SYNTHESIS.*

By G. Perry Grimsley, M. A., Baltimore, Md.

I. HISTORY AND DEVELOPMENT.

The artificial reproduction of minerals dates far back among the ancients, though their work is better termed an imitation of minerals, for they considered reproduction as we understood the word, to be impossible. Some of these ancient people became expert in the imitation of gems by colored glass; they even took certain white stones, as quartz, topaz, and colored them red to imitate rubies, their incentive being pecuniary rather than scientific.

Little or no progress was made in the work until the eighteenth century, when the philosophers began to peer into the book of nature, to see what was written therein, instead of trying to write the book themselves. Fanciful theorizing gave way to observation.

Leibnitz noted the effects of sublimation in the furnaces of Langesheim, near Goslar, where a number of minerals like lead and copper were melted: from this was formed zinc and calamine, while the copper changed color and became chrysocolla. He then ventured a suggestion, that if the elements of cinnabar were treated in a similar manner, this mineral would be formed. Then followed Bacon, who furnished many arguments to prove that minerals could be produced artificially. Henckel, in 1725, expressed an ardent desire to realize mineral synthesis, as did Blegny, Boyle and others.

Thus, the dark curtains of superstition and ignorance were pulled aside, revealing a new field for work and conquest. The first attempts were crude and unsuccessful. Bromel, in 1727, tried to reproduce petrefactions of wood and bone and incrustations as of lime, but without success.

*Based on the works of Meunier, Foque and M. Levy.

Foremost in the development of experimental geology stands James Hall, a pupil of Hutton, who, early in the present century, formed carbonate of lime in a closed tube, by pure igneous fusion, from the dissociated vapor of its elements. Through this result and the description of artificial accidental syntheses given by Haussman, Mitscherlich and others, Berthier was led, in 1823, to form minerals by mixing their elements in chemical proportion. St. Claire Deville, Caron, Debray and other students advanced the work by addition of fluxes and mineralizers. Manross employed the means of double igneous decomposition with success. Ebelman achieved success by aid of igneous evaporation and dissolution by boric acid. Gay Lussac, Durocher, used gaseous in place of liquid means. Senarmont and Friedel made the great successful innovation of introducing the action of water under very high temperatures. Then came the work of Daubree, which was epoch-making. He obtained very high temperatures, and what were up to this time unattainable pressures.

The cause of the long delay in the progress of mineral synthesis was the idea so firmly fixed in the minds of the old chemists, that nature worked by mysterious means, and had at her disposal indefinite time, enormous masses, and supposed forces out of all proportion to those used in the laboratory. Then, how was it possible in a crucible, with certain number of grammes of matter, to reproduce a crystal of same kind, and association, as those which the volcano ejected, a crucible million times larger and under enormous pressure and temperature? The answer seemed too clear to admit any such vain attempt. The underlying law of proportion was unseen, but it only needed more careful observers to discover it.

With the crude means and limited experience at hand, progress was very slow down to the middle of the present century. At the beginning of the cycle, there existed the two opposing geological camps — the one attributing everything to fire, the other all to water. After long years of bitter discussion, the union was accomplished through the efforts of Lyell and his followers; at the same time the accumulating observations overthrew another old idea, and proved that a

mineral is not necessarily of one method of origin, but may be of very different methods, which can be determined. It was not considered possible that a homogeneous magma could at the same time give rise to different minerals.

An envelope of mystery was thrown around the origin of minerals, and they were regarded, even by Zirkel, as the work of a kind of vital force.

Many causes contributed to the rapid progress of the science in the last twenty years; the strong prejudices of the ancients are disappearing, observations and processes of investigation have acquired a remarkable precision, materials and apparatus in the laboratories have been greatly improved. When the new crystals were formed, they were found to be small and often imperfect, not to be compared in beauty to cabinet specimens, but far surpassing these in value in settling questions of origin. They could not be properly studied without the use of the microscope. Then it was found that the minerals possessed inclusions, which threw much light on the origin of the mineral. If these were vitreous, the origin was vitreous, and excluded the action of volatile agents; when these are aqueous, the intervention of water is ndisputable. Liquid carbonic acid, when found in minerals like quartz, topaz, and beryl, give evidence of their formation under great pressures. As mineralogical micrography was developed, the varied order of consolidation of the different minerals of rocks was discovered. The state of repose or movement of the minerals during or after their consolidation is manifested in the diversity of structure; such as zones of growth, corrosions, flow structure and others.

For example, micro-pegmatite on observation is found to be an intimate mixture of quartz and orthoclase, thus proving that two minerals can crystallize from the same magma at the same time.

In rocks, the mineral lencite is always formed before the feldspar and pyroxene. As such rocks have an igneous origin, it was regarded probable that lencite crystallized at a temperature higher than that of the other silicate minerals. This notion served as a guide in the reproduction of lencite with its associated minerals. Then the observation of the artificial product proved the assumption which served as the point of departure.

Another factor which has contributed largely to the onward progress of this new work is the perfecting of apparatus for laboratory work. This enables the workers to obtain very high temperatures and strong pressures under conditions of almost perfect security.

For high temperatures, prolonged for a considerable time, it was necessary to have recourse to the furnaces of industry, which are manifestly inconvenient. The employment of the Schloesing furnace permitted to obtain in the laboratory very high temperatures, using illuminating gas as the combustible. The combination furnaces of Leclerc and Forquignon (1875), and three years later the tube of Damorseau, furnishing a draft by a current of gas, secured very high temperatures in a small space, and maintained these without variation.

The strong pressures are obtained in tubes of glass, sealed by a lamp, and heated to 200 degrees. A first improvement consisted in inclosing them in metallic coverings hermetically sealed and containing a small quantity of water. Daubree attained thus a temperature of 350 to 500 degrees. The iron and brass first used were altered by the water, so Friedel and Sarasin doubled the tube and lined the interior with platinum. The hermetical closure of the tube caused great difficulty for a long time. Friedel and Sarasin overcame this by using a platinum band fastened around the circumference of the mouth of the tube as a loop, and fastened by bolts on the sides. Foque and Levy have modified this by changing the disc and obtaining the pressure by a stirrup which rests upon the loop and presses firmly to its place the steel plate at the top of the tube. This method of closing they find perfectly safe, and it resists pressures which rend the tube, whose walls are one centimeter thick, with interior diameter of the same size. Friedel and Sarasin improved this by applying the closure to both ends, so facilitating the cleaning of the interior. The next improvement was made by Wiesnegg, who, in 1879, designed a stove, in which, with coal gas as fuel, many such tubes could be heated at the same time to a temperature near 500 degrees. Automatic valves were constructed, regulating supply of gas so as preserve a uniform temperature.

It is seen by this review of growth that the first workers in the field were chemists, and the difference between a chem-

ical and mineralogical synthesis was long overlooked. In the chemical sense, if the artificial product has the definite chemical composition, reaction, and physical properties, as density, boiling point, etc., the synthesis is complete. But in mineralogical synthesis, in addition to this, there must be entire agreement of the resulting product with the natural one morphologically. It must have the crystal form and also the characteristic type as in nature, with the optical and physical properties to be perfect. As an illustration, the elements of orthoclase might be fused, and the resulting product have the physical properties and composition of the mineral, but this could not be termed a mineralogical synthesis unless the crystal form be produced.

In order to make a perfect synthesis, certain conditions must be fulfilled:

1. The artificial mineral must possess the chemical composition of the natural one.

2. The new mineral must belong to the same crystal system, with like forms and crystallographic parameters. The analogy should even be followed in the twins and the development of certain common faces.

3. The identity must be continued in the internal structure, as revealed by the microscope — in optical properties, cleavages, inclusions, and mode of alteration.

4. The mineral should also show the associated minerals occurring in the rock and in the same mode of association.

5. There must, through the whole process, be a perfect agreement of the conditions of the experiment with those supposed to exist in the natural origin.

6. When all these conditions are fulfilled, it is very probable that we have employed the exact means which held in the natural process. As a final control comes the geological examination as to association, etc.

Under the head of artificial minerals we must exclude those accidentally formed in the industrial works; as, graphite on the walls of iron furnaces, for such do not answer the question of the origin of such minerals, for the reagents and conditions remain unknown. Nevertheless, the recorded observations of such products have aided reproduction in the laboratory. Such observations have been noted especially by German

workers, while the home of actual laboratory investigation is in France. French writers give as explanation for this fact, that they did not believe in collecting facts without co-ordination; and their progressive genius led them to make hypotheses and then to make experiments to prove these. Early in the century Berthier and Ebelmen united their studies in mineralogy and chemistry, and it is on this union that mineral synthesis as a science rests.

The forces at work in the formation of minerals escaped the observation of mineralogists, and were considered outside the domain of chemistry. While this union is necessary for a perfect synthesis, the two are essentially distinct, both in methods and results. The chemist aims at a production of the mineral as found in nature, while the mineralogist, in addition, aims at an analogy with natural processes. Thus, the chemist deposits copper by electrolysis, but this does not show the origin of copper as found in nature. His task is the easier, for he uses his reagents at pleasure, aiming only at the final product.

UTILITY.

Having sketched the history and development of this work, we may now consider the practical side, and see its aim and what it has accomplished.

1. Synthesis throws light on the mode of the natural formation of minerals and rocks. Thus, even down to late times, water was considered to play an important part in the formation of a great number of volcanic rocks, and to be indispensable in formation of basalt. Yet basalt and all the modern volcanic rocks have been formed by purely igneous fusion.

2. Synthesis permits the determination of the exact composition of certain minerals impure in nature, notably, chiastolite, garnet, staurolite, and a large number of metamorphic minerals. Leucite always shows in nature potash, lime, and soda; yet the artificial mineral is made with no other base than potash. Likewise, in case of oligoclase, labradorite, and anorthite.

3. The majority of the natural minerals are complex combinations, in which many bodies are introduced by isomor-

phous agency. In the pyroxenes, for example, magnesian protoxide of lime and iron figured, and mineralogists gave special names to these types; as, diopside, augite, which were characterized by a certain base united with silica. The varieties furnished by nature differed from the theoretical ones in chemical composition, values of the dihedral angles, position and value of axes of optical elasticity. Synthesis alone furnished the theoretical types and gave the exact physical measurements.

4 Mineral synthesis determines the individuals belonging to a family, and discovers the true isomorphism of the series in question. The family of the spinels is composed of many members, which pass from one to the other by isomorphous means, as demonstrated chemically by Ebelmen. Inversely the artificial reproduction of the feldspar series proved the individuality of oligoclase and labradorite, and the isomorphism of albite and anorthite, with a possibility of a mixture of the two in all proportions. One was formed with a composition between oligoclase and labradorite, showing two series of microlites, one showing longitudinally as natural oligoclase, the other, with a maximum angle near thirty degrees, as natural labradorite. If the formula of the oligoclase be varied in a basic sense, immediately appear microlites of labradorite to the exclusion of anorthite.

5. Certain mineralogical types absent in, yet suggested by, nature, have frequently been made artificially. Thus have been obtained a pure soda oligoclase, a potash nepheline, showing the relative isomorphism of potash and soda.

6. On the other hand, certain forms unknown in nature have been obtained artificially, as in the crytallized phosphates of Debray, the sharp-pointed quartz of Hautefeuille, and chalcedonic nepheline of Foque and Levy.

7. A very considerable service is rendered by mineralogical synthesis by the production of a series more complete than the similar natural one, so the limits of isomorphism are shown with clearness. Thus, Ebelmen completed the spinel series and showed the relation of the ferrites, chromites, and aluminates. The experiments of Hautefeuille, Foque, and Levy, showed the extension of the feldspar family, forming feldspars with bases of lithia, barytes, strontium and lead.

8. Geology is encumbered with hypotheses, and observation in many cases is insufficient to settle definitely the doubts. It then is left to synthesis to enlarge the field of observation and to furnish definite solutions. Thus, the origin of granite was one of the great problems confronting geologists. The opinion that it was purely igneous prevailed in the science for the first part of our cycle, replacing the neptunist theory of Werner; but the difficulties were increased a little later when, by means of the microscope, it was found that the quartz was consolidated after the other minerals, which was against the idea of a purely igneous fusion of the granite. Élie de Beaumont (1849) accepted the intervention of water, and insisted, for proof, on the number and frequency of the minerals sublimed on the periphery of the massive granites. He supposed the water to be contained in the form of inclusions in the quartz, a supposition which was proved ten years later by Sorby, and gave thus a decisive argument for the mixed origin of granite. When synthesis was called in to answer the question, it proved conclusively the impossibility of obtaining granite by purely igneous fusion.

II. METHODS OF SYNTHESIS.

These methods will, of necessity, vary with the aim in the mind of the investigator, but he must at all times bear in mind the conditions outlined in the previous paper. The aim is to imitate and form the minerals as in nature, under like processes, using only such agents as can be positively affirmed to exist in nature. While in very many cases high temperature, high pressure, and long time are required to form the mineral, yet there is a large series of minerals formed under ordinary conditions of pressure and temperature. In this last group are found the sulphates, carbonates, phosphates, zeolites, ores, and certain water-containing silicates.

The influence of time is well illustrated in the case of certainly apparently amorphous precipitates, which, in a few months, show small crystals, and in the course of a few years form crystals of considerable size.

For the purpose of description, the synthetical methods will be divided into two general groups: 1. The crystalliza-

tion of a substance already formed, but existing in an amorphous state. 2. The formation of a mineral substance and crystallization at the same time.

Under the first group, crystals are formed; by passage of gaseous condition to solid by *sublimation;* by a change from fluid condition to solid, and this either from *solution* or *fusion;* by a change from amorphous body to crystalline by the process known as *devitrification.*

Under the division of *sublimation* would be included those processes by which a body, in a gaseous state, is changed by rapid cooling to a solid. This is a process easily used in the laboratory, as is seen in heating amorphous arsenic in a glass tube when crystals are formed on the colder portions.

It is found in many cases that the intervention of certain gases, as hydrogen, nitrogen, fluorine, water, greatly facilitates the crystallization. These gases are called by the French, "*mineralizers.*" When amorphous sulphate of cadmium is heated in a current of hydrogen, greenockite crystals were formed. The action is often obscure and not easily understood, as when crystalline zinc is formed by passing a current of nitrogen over the amorphous sulphate.

Deville converted amorphous tin oxide into beautiful cassiterite crystals by aid of hydrochloric acid. Fremy, by aid of fluorine, formed sapphires and rubies weighing .075 grams, from the amorphous alumina.

Boric acid was so successfully used by Ebelmen, in the formation of the spinels, that he concluded it must be universally present through the earth's crust.

Another method mentioned above was the formation out of *solution.* This may take place by evaporation, as in all the easily soluble bodies, at ordinary temperatures, seen best in rock salt, sylvine, alum. Or it may take place through concentration, by lowering the temperature, best illustrated by the precipitation of gypsum from sea water. Finally, it may take place by a variation or change in the character of the solution, as the removal of gases Thus, if an aqueous solution of carbonate of lime loses its carbonic acid, calcite is precipitated.

A third category named above was the formation of minerals from the fusion of amorphous substances. Many

substances when fused and slowly cooled, form crystals; as, gold, silver, copper, antimony, and sulphur. It was found when gypsum was fused and cooled, anhydride was the result. The temperatures required for the fusion are often so great that certain gases, as fluorine, nitrogen, and others, are used to aid in lowering the temperature, as in the case of scheelite and zinc-blende.

By the use of certain known solids, as fluxes, great assistance was given. Ebelmen, by use of borax, formed crystals of corundum. G. Rose, by means of certain salts of phosphorus, united with the oxides of silica, titanium, and iron, formed tridymite, anatase, hematite. Bourgeois, likewise, formed calcite, witherite, and strontianite, through a fusion of the carbonates of the bases, with sodium and potassium chlorides. Berthier formed, by same process, olivine and some of the pyroxenes. In this connection may be mentioned the experiment of Sir James Hall, in which he fused a crystalline rock (ophite) to a glass; after this had cooled he re-fused the glass, and by slow cooling formed again the crystalline rock. By this means he proved that very high temperatures were acting in the formation of the volcanic rocks.

The next division of the changes is that by *devitrification.* It was early observed that certain glasses, long exposed, showed a tendency to crystallization. This was first observed by Reaumer in 1727, and was further investigated by Hall in 1790. Leibnitz, finding that vitreous rocks were associated with crystalline ones of same composition, as obsidian and trachyte, concluded that the latter was derived from the former by this peculiar property called devitrification, so he concluded that "glass was the base of rocks."

The most complete studies on this subject were made by Fremy in his experiments on basalt. He heated a number of specimens for eight days and found a change of color and the formation of white feldspar crystals in a crystalline ground mass. Four of these specimens were subjected to less and less heat, and as a result it was found that the higher the temperature the smaller were the bubbles. By similar means, refractory clay, heated, showed crystals of sillimanite. Appert, in 1890, observed that in soda and calcium glasses, quartz in

thin plates, wollastonite and diopside, were common products, while in magnesian iron glass diopside was formed.

Having passed in review the methods of crystallizing amorphous substances, we will now consider that group of methods in which the chemical reaction or formation takes place at the same time as the crystallization.

Again, under the head of *sublimation*, minerals may be formed by the action of one gas upon another, as in the mixing of oxygen and hydrogen sulphide to form sulphur. Or there may be an action of a gas or gases on molten or solid bodies. In this case the temperature used may be much reduced. Deville formed corundum by action of water vapor on the chloride of alumina. Margottet, through the influence of sulphur vapor on native silver, in presence of a stream of nitrogen, formed *argentite*.

The temperatures in these experiments were high, being above the fusing point of the substance. The sulphides and sulpho-salts were formed through action, hydrogen sulphide on the chloride, oxide, or carbonate, of the mineral sought; for example, pyrite was formed by action of hydrogen sulphide on iron oxide, at a temperature not far above the ordinary. At a temperature of 400 degrees. millerite, covelline, cupferite, were formed. Minerals may be formed and crystallized from a fused state, by melting together the constituents. By mixing silicic acid, iron oxide, alumina and carbonates of alkaline earths, then fusing and cooling, are formed leucite, augite, nepheline, anorthite, cordierite, at temperatures of 1,200 to 1,500 degrees.

These high temperatures are troublesome, so means are sought to avoid them. Certain fluxes are thus found useful; these are of two kinds: one in which the flux exerts no chemical influence on the mixture, as in case of garnet, formed by adding to the constituents some easily-fused chlorine metal, as manganese or calcium chloride. This method was used by Hautefeuille to form leucite. Or, again, the flux may exert some chemical action, as in the experiments of Gorgeu, who fused calcium fluoride and chloride with silica, obtaining augite and wollastonite. Micas, also, were formed by melting together silicic acid, alumina, and fluorides of sodium, calcium, and magnesium.

Another method of mineral formation is through a chemical reaction in the wet way or by solution agencies. The action of hydrogen sulphide on metallic chlorides and oxides in solution forms sulphides. So lead, iron, or silver chlorides, in solution of sodium carbonate, in an atmosphere of hydrogen sulphide, yield crystals of the sulphides. This method was used very successfully by Weinschenck. These minerals were formed by the action of gases on solutions. Other minerals have been formed by the influence of a solution on a solid body.

If sodium sulphide is brought in contact with an oxide of some metal under ordinary pressure and slightly-raised temperature, good sulphide crystals of that metal are formed. Doelter and Bischoff used this method to form hematite, pyrite and galena. This action of one solution on another at ordinary temperature is a fruitful source of new minerals. If sodium sulphate and lead chloride be brought together in solution, fine crystals of anglesite are formed. This method was used by Drevermann and Becquerel. Using the last method with high temperatures and pressures malachite was formed by influence of sodium carbonate on copper sulphate.

A few minerals form amorphous precipitates at ordinary temperature, but when this is raised, the substance crystallizes: as, magnetite in mixture of carbonate of sodium and chlorides of iron. Friedel and Sarasin formed orthoclase at 550 degrees by action of alumina silicate on the calcium silicate. Other minerals thus formed were, albite, quartz, tridymite, pyroxene, and wollastonite.

Pressure alone has been found effective in formation of a limited number of minerals. Spring formed chalcocite from copper filings and powdered sulphur under a pressure of 5,000 atmospheres.

Electrolysis has been successfully used, and copper, gold, lead, and the like, have been produced. One mineral, which has long withstood attempts at its formation, has been artificially reproduced within the last few years.

A description of this experiment will illustrate, in a general way, the manner of conducting a synthetical mineral reproduction.

Hornblende and tourmaline were regarded as outside the field of artificial formation, because all attempts at their production were fruitless.

Von Chrustschoff, of St. Petersburg, who had already won a reputation in this work, attempted the formation of hornblende. He found the weak points in the glass tubes were the terminations, so he improved this by prolonging the tube into a long neck and funnel, so that its thickness was equal throughout. The tube held about twenty-five cubic centimeters of liquid. He next constructed an oven which would hold a number of these. Each tube was inclosed in an iron capsule, and these placed in an iron retort, surrounded by a second iron cylinder. The space between the two was filled with sand. The whole apparatus was covered within and without with asbestos, and heated by two to six Bunsen gas burners. In the tubes was placed a stiff gelatinous mass made by mixing a three per cent solution of coloid silica, an aqueous solution of alumina, iron oxyhydrate, lime water, fresh magnesia hydrate, a drop of soda lime alkali. Out of the five tubes, three remained unbroken at the end of three months. The heat was turned off at night, and so was interrupted; the temperature maintained was 550 degrees centigrade.

At the end of the period, examination of the contents revealed a number of hard grains of dark color. These were found to be prismatic crystals, one millimeter in length and a quarter millimeter thick, perfect enough to be measured. All the chemical, physical and optical properties were identical with those of *hornblende.* The crystals were of greenish-color pleochroic, and showed beautiful zonal structure.

Associated with these were a number of crystals determined as pyroxene, probably diopside; colorless grains, possibly analcite; quartz crystals, two millimeters in size, with fluid inclusions; thin rhombic tables of orthoclase of the adularia type. This is the association one would expect to find in a natural rock, and so makes a mineralogically and geologically perfect synthesis.

[TO BE CONTINUED.]

NEW PHÆNOGAMS FOR THE OHIO FLORA.

By Wm. C. Werner,

ASSISTANT IN BOTANY, OHIO STATE UNIVERSITY.

Read at the meeting of the Ohio Academy of Science, held in Columbus, December 28 and 29, 1893.

Last Spring I published a list of new plants for Ohio.* It is the interest botanists took in this list that prompts the publication of another of similar character.

It will be noticed that a few species here given are far out of their range, as given in Gray's Manual. I feel confident that a systematic survey of the State would add many more such plants to our lists. A considerable portion of my spare time the past Summer was spent in reducing to order the undetermined material here at the University. I take pleasure in acknowledging my obligations to the following persons, for aid rendered in identifying plants, and verifying my own determinations in this work: Prof. F. L. Scribner, Dr. N. L. Britton, Prof. L. H. Bailey, Prof. J. M. Coulter, Mr. M. S. Bebb. I am especially indebted to Mr. M. L. Fernald for the painstaking manner in which he compared a large number of specimens for me at the Harvard University herbarium.

Most of the specimens here cited were collected previous to the publication of the former article, but were still undetermined. This accounts for their appearance at this late day.

Lychnis coronaria Desv. Apparently wild at "Christmas Rock," Fairfield Co., W. A. Kellerman.

Sagina apetala L. Borders of streets and sidewalks, Ironton, Lawrence Co., Wm. C. Werner.

* Bulletin of the Ohio Agricultural Experimental Station, Technical Series, Vol. I, No. 3. April, 1893. Article XXI, pp. 235, 240.

THASPIUM BARBINODE ANGUSTIFOLIUM Coult & Rose. Toledo, J. A. Sanford; near Cleveland, Wm. Krebs.

ASTER DRUMMONDII Lindl. Georgesville, Franklin Co., Wm. C. Werner.

ASTER LATERIFLORUS BIFRONS Gray, (*A. diffusus bifrons* Gray). Painesville, Lake Co., Wm. C. Werner.

ASTER LATERIFLORUS THYRSOIDEUS Gray. (*A. diffusus thyrsoideus* Gray.) Painesville, Wm. C. Werner.

ASTER NOVI-BELGII LEVIGATUS Gray. Ironton, Lawrence Co., Wm. C. Werner.

BIDENS CONNATA COMOSA Gray. Painesville and Columbus, Wm. C. Werner.

COREOPSIS SENIFOLIA Michx. Hillsides, near Ironton, Lawrence Co., Wm. C. Werner.

"COREOPSIS VERTICILLATA Willd. Grows on the rocky heights across the river from Portsmouth. Flowers yellow; in June, two to three feet high. The leaves are lanceolate, like those of C. senifolia, and mostly glabrous like those of C. verticillata. This may be the C. senifolia, Michx. I can not perceive any essential differences in Elliott's descriptions of the two species, at least, in those parts which the immaturity of my specimens permit me to inspect * * * * *" Dr. John L. Riddell in Supplementary Catalogue of Ohio Plants. Western Journal of the Medical and Physical Sciences, April, 1836, p. 577.

The coreopsis here referred to is undoubtedly the same as my plant from near Ironton, which, in this case, can hardly be called new to our Ohio lists. I insert C. senifolia, however, that the attention of Southern Ohio collectors may be called to it.

LACTUCA PULCHELLA (Pursh) D. C. Columbus, Wm. C. Werner.

SENECIO VISCOSUS L. Admitted into the former article, proves to be a large pubescent form of S. vulgaris.

VERNONIA DRUMMONDII Shutlew. (*V. altissima grandiflora* Nutt.) Geneva, Ashtabula Co., Miss Sara F. Goodrich.

VACCINIUM CANADENSE Kalm. Near Toledo, J. A. Sanford.

CHIOGENES HISPIDULA (L.) Torr. & Gray. Tamarack Swamp, near Myer's Lake, Canton, Stark Co., E. W. Vickers.

CUSCUTA CEPHELANTHI Engelm. (*C. tenuiflora Engelm.*) Ashtabula Co., Miss Sara F. Goodrich.

SALIX CORDATA ANGUSTIFOLIA Anders. This form is quite frequent in the vicinity of Columbus. It has also been collected at Lima, Allen Co., by Prof. Kellerman.

SALIX intermediate in character between S. CORDATA and S. ADENOPHYLLA. Cedar Point, Ottawa Co., Aug. D. Selby. The finding of S. cordata with adenophylla characters in this region is as yet unexplained, since the latter has not yet been found within our limits.

POTAMOGETON AMPLIFOLIUS Tuckerm. Congress Lake, Stark Co., W. L. Crubaugh.

CAREX ASA-GRAYI HISPIDULA (Gray) Bailey. (*C. Grayi hispidula* Gray. Ashtabula Co., Miss Sara F. Goodrich.

CAREX EBURNEA Boott. Cuyahoga Falls, Summit Co., Wm. C. Werner.

CAREX GLAUCODEA Tuckerm. Central College, Franklin Co., Aug. D. Selby.

CAREX GRANULARIS HALEANA Porter. Painesville, Wm. C. Werner.

CAREX INTERIOR CAPILLACEA Bailey. Licking reservoir, Licking Co., Wm. C. Werner. For description, see notes on Carex, by Prof. L. H. Bailey, Torr. Bull., Nov. 15, 1893, p. 426.

AGROSTIS ALTISSIMA (Walt) Tuckerm. (*A. elata* Trin.) Cleveland, E. Claassen; Painesville, Franklin Co., Fairfield Co., Wm. C. Werner. These are all slender forms and do not correspond exactly with New Jersey specimens. They are, however, more closely allied to A. elata than to A. perennans.

AMMOPHILA ARUNDINACEA Host. Cedar Point, Ottawa Co., Aug. D. Selby, E. Claassen.

PANICUM CAPILLARE FLEXILE Gattinger. Columbus, Wm. C. Werner. See description in Contributions from the U. S. National Herbarium, Vol. III, No. 1, February 25, 1892.

PANICUM COMMUTATUM Schultes. Sugar Grove, Fairfield Co., Ironton, Lawrence Co., Wm. C. Werner.

SPOROBOLUS BREVIFOLIUS (Nutt.) Scribn. (*S. cuspidatus* Scribn.) Georgesville, Franklin Co., Wm. C. Werner.

OBSERVATIONS ON SOME ENTOMOPHTHOREÆ.

By F. M. Webster, M. Sc.

Read before the Ohio Academy of Science, December 28, 1893.

It is certainly to be regretted that there are not more field workers in this most interesting line of research. Scarcely a season passes that does not witness one or more emphasized attacks from these wonderful plant growths, and I do not believe we at all understand the magnitude of their influence in the interaction of organisms that is continually going on about us. True, they are, as a rule, conspicuously abundant only during seasons when their respective hosts are present in excessive numbers. But, as this sooner or later occurs with most of our common insects, there is usually no lack of opportunity to enlarge our knowledge of their habits and interpositions. For my own part, I am usually too overwhelmed with strictly entomological work to give them more than casual attention, and, besides, have neither the knowledge or literature requisite to a study of them that would be of any value. In Ohio, the Summer of 1893 developed out-of-door attacks of what I supposed, at the time, to be *Empusa muscæ* Cohn. Unfortunately, not being aware of the importance of this exceptional phenomenon, no specimens were secured. On the outskirts of the city of Ashtabula, on June 22, I saw a considerable number of affected flies attached to the leaves of some fruit trees that were standing in a small enclosure in which a number of swine were confined. The flies were evidently attracted to the locality by the droppings and refuse feed, and found a resting place on the leaves, where they were overcome by the disease, which might have originated in the *Syrphidæ* in attendance upon Aphides. On two other occasions, in other localities, but under similar environments, the same observation was repeated, and seemingly on the same species of

Muscidæ. Only once before had I observed this out-of-door attack, and that was on September 5, 1884, in a field of wheat stubble, the host this time being a species of *Oscinis*, which I afterward reared from larvæ infesting the stems of the young wheat plants.

In the same locality, near Ashtabula, the larvæ of *Phytonomus punctatus*, a recent acquisition to the coleopterous fauna of the State, were being almost exterminated by *Empusa sphærosperma* (Fres.), not one per cent of these larvæ, on an average, reaching maturity, and all efforts to transport them home by mail proved fruitless. It is a matter of surprise to me that, if, as Dr. Thaxter believes, this species is correctly determined, and is also, with its American host, an inhabitant of Europe, we hear no reports of their sustaining similar relations, the *Phytonomus* having been destructively abundant in the clover fields of Italy for many years, and, apparently, at rather irregular and widely-separated intervals, thereby indicating the presence of some restraining element. My fruitless attempts to transport the larvæ, in a healthy condition, in this case, though the distance was not over 125 miles, was almost paralleled by a similar attempt some years ago to transport some larvæ of a species of *Pachyrrhina*, one of the *Tipulidæ*, even a shorter distance. In this case the larvæ were destroying young wheat in a field in Western Indiana, in April, 1890, and though large numbers were obtained for study, being apparently in good health when secured, nearly all died within three days. In one case a larva constructed its vertical cell in the earth in the breeding cage, and during the following night pupated, but in the morning was found on the surface several inches distant, with the side of the body next to the soil covered with white spores. The species was not clearly referable to any described, and was named provisionally *Empusa pachyrrhinæ* by Dr. J. C. Arthur.

Throughout many portions of the country the rapidity with which the barbed wire, as a fencing material, has come into almost universal use is well-nigh phenomenal. But very soon after its adoption for this economic purpose, the discovery was made that domestic animals were more or less liable to sustain injury from contact with the barbs. This led to a modification, to the extent of placing one board horizontally above

the wires, and, while done expressly for the protection of the animals, it also took on an entomophthological aspect wholly unexpected by the naturalist. The fall brood of the larvæ of *Spilosoma virginica* Fabr., familiarly known as the Common Yellow Bear, reaches maturity in September and early October, and appears to then acquire a somewhat nomadic habit of life, possibly being in search of a suitable place for cocooning. In their travels they seem to take advantage of fences, and convert them into highways, over which they travel in great numbers. Now, with a fence of rails or boards, the travel is distributed over all of these, though the uppermost seems to be preferred. A barbed wire fence is well-nigh impassable for these caterpillars, on account of the difficulty of crawling along the wires and over an occasional barb which stands in the way. The addition of the top board to a fence of barbed wire settles the transportation problem with these larvæ, and they crawl along upon the upper edge in great numbers; but, as with mankind, disaster overtakes them in the midst of prosperity. This fall brood of larvæ seems especially liable to attack from a fungous disease, *Empusa aulicæ* Reich., as determined for me by Dr. Thaxter, of Harvard University. A caterpillar, when affected by this *Empusa* becomes first paralyzed and limp, but later it is rigid and attached so tenaciously to the board that it only disappears by becoming disintegrated and washed off by rains. Now, when a caterpillar dies from this cause, it usually becomes firmly affixed right in the way of the migrating larvæ, so that one of these can scarce pass in either direction without rubbing against the corpse, as the way is only an inch in width. In thus coming in contact with the dead body of its fellow, in all probability some of the spores of *Empusa* become attached to its own body and soon do their work, the dead, as before, lying in the narrow path and adding to the danger of other travelers. Now, one can very readily see that in a short time the narrow way will become so filled with dead that to travel for any distance along this highway without contracting this fungoid disease is almost an impossibility. In proof of this, the upper edge of this board, where it is used, becomes literally strewn with corpses. In a distance of forty-eight feet, on a fence of this description, near Wooster, Ohio, in October, 1892, I

counted at one time the dead bodies of seventeen of these caterpillars, and clustered on the top of a post, within an area of twelve square inches, were six additional ones, all rigidly attached to the wood, some of these bodies remaining in place until the following June.

As indicating the probable effect of this scourge, I will say that at a corresponding season of the present year, 1893, there is in this same locality scarcely a larva of this species to be found. As the caterpillars are not gregarious, and scatter soon after hatching from the egg, the chances of their being reached by the spores of the *Empusa* are very few, unless they rub against a diseased larva, or come within a certain radius of such a one when the spores are thrown off, or "shot," as it is termed. Hence, as now appears, this mortality is largely due to the cause indicated, and which seems to be a powerful agent in holding the species in check.

From the fact that the victims of *Empusa*-attack seek the very highest points within their reach before they become helpless, it may be suggested that they were contaminated before reaching the fence, and only took to it as the highest object within their reach. This appears to me to be hardly possible, except to a limited degree. The chances of infection elsewhere were comparatively small at most, and I have observed the caterpillars, in other years, and in widely-distant localities, crawling along the top board of fences in precisely the same manner, with no indication whatever of the presence of *Empusa*. So far as I have been able to observe, the victims become helpless soon after contagion, though it may be that much depends on the weather at the time. However, there seems to be no good reason why, even under circumstances most likely to delay the effects of the contagion, dead larvæ should not have been found on the weeds and other herbage along the fences, which was but rarely the case. There appears every indication that infection took place after the victims reached the fence, though, of course, this is by no means proven.

It seems possible that a larva might occasionally become infected by eating of a leaf that had been partly devoured by another in which the disease had reached an advanced stage; or spores, in being thrown forth from a defunct larva, might

have fallen on such leaf and been devoured, or brought in contact with the body of a healthy caterpillar by the latter crawling over and among them. As it is quite improbable that the spores would winter over, and remain for a year on the fences, the disease must have been first conveyed to the fences by affected larvæ from the adjoining vegetation.

That the hypha of germination, after it has entered the body of the host, develops with some rapidity is admitted by all, and I had what appeared to be a good illustration in August, 1891, at Columbus, Ohio. This time the host was *Diedrocephalus mollipes*, and the *Empusa* possibly *E. jassi* Cohn. A very small plat of wheat plants were grown in the orchard of the Agricultural Experiment Station, which plat being fully one hundred feet from any grass or similar herbage. For a considerable time I found regularly every day or two, one, and rarely two victims rigidly fixed to the leaves of the plants, with wings outstretched in all cases. The plat covered little more than a couple of square feet area, and it was easy to watch the number of visitants, which seldom numbered more than two or three at the same time. In fact, it had the look of a veritable death-trap, to which one victim after another was allured, became infected and died. This fatality was doubtless aggravated by the drouth, which was very severe at the time, while the wheat plants were kept fresh and vigorous by frequent watering. No amount of search in the vicinity indicated any such ravages elsewhere.

In the foregoing I have used the generic name *Empusa*, but not without serious doubts as to its validity. This name is also used for a genus in *Orthoptera*, a large pale-green mantis, common in the countries bordering the Mediterranean Sea, being known as *Empusa pauperata* Fabr. The use of this name generically, in entomology, has priority over its use in designating a genus of Entomophthoreæ; besides, to continue to use it in the latter connection might precipitate a complication, as in this country, at least, *Empusa* is known to affect several *Orthoptera*.

MANUAL OF THE PALEONTOLOGY OF THE CINCINNATI GROUP.

BY JOSEPH F. JAMES, M. SC., F. G. S. A., ETC.

PART V.

(Continued from Vol. XV, p. 159.)

GROUP II. *Discoid:* Free, plano-convex, concavo-convex, or conical; upper surface bearing apertures, the lower covered with an epitheca.

a. Corallum concavo-convex.
- * epitheca concentrically wrinkled.
  - † calices generally similar.................. 5
  - †† clusters of larger calices.
    - ‡ calices polygonal.................... 6, 7
    - ‡‡ calices circular or sub-circular....... 8, 9
- * epitheca with radiating striæ; calices circular, 10, 11
- * epitheca with striæ extending from a point at one side................................ 12
- * epitheca with a groove...................... 13

b. Corallum conical.
- * edges thin.
  - † epitheca with a grove.... 13
  - †† epitheca concentrically wrinkled.
    - ‡ monticules small......... ....14, 15
    - ‡‡ monticules prominent............... 16

5.—M. DISCOIDEA (James) Nicholson, 1871.

Corallum free, discoid, concavo, or plano-covex, sharp-edged, from five to eight lines in diameter, and about one line in thickness in the center; under surface generally concave, covered with a thin, smooth and irregularly striated epitheca, usually with two or three marked, concentric

wrinkles; upper surface, carrying the calices, gently convex, and without any monticules; calices polygonal, sub-equal, occasionally collected into maculæ; no interstitial cells; spiniform corallites situated at the angles of junction of the cells; corallites directed at right angles to the base, thin walled at first, but becoming thickened; tubes crossed by a moderate number of complete, horizontal tabulæ, frequently placed at corresponding levels in contiguous tubes. (Cat. Foss. Cin. Gr. (name only). Nicholson, Quart. Jour. Geol. Soc., Lond., vol. 30, 1874, p. 511, as *Chætetes discoideus*; Genus Montic., 1881, p. 193).

Locality.—Cincinnati, O., near Toronto, Canada; in Wisconsin, etc.

Remarks.—This species is readily recognized by the disc-like form of the corallum, with the under surface concentrically striated, and the upper one with tubes of a uniform size and without monticules.

6.—M. NEWBERRYI Nicholson, 1875.

Corallum in the form of a thin, sub-circular or semi-circular expansion, 10 lines to one inch or more in diameter, and $\frac{1}{40}$ of an inch thick; generally free, but perhaps occasionally parasitic, and with a basal epithecal membrane; surface smooth, but with groups of corallites larger than the average, and forming low, inconspicuous elevations; calices polygonal, thin-walled, and interstitial cells observable in well-preserved specimens; in cross section the corallites are oval, touching each other at some points, the interstices filled with numerous small and variously-shaped corallites; tabulæ of the large corallites imperfect, forming a series of vesicles on one side of the tube, the other being open and without them; small corallites with closely set, straight tabulæ. (Pal. of Ohio, vol. 2, 1875, p. 212, as *Chætetes newberryi*; Genus Montic., 1881, p. 212). (*Aspidopora parasitica* Ulrich, 14th Ann. Rept. Minn. Geol. and Nat. Hist. Survey, 1886, p. 90. *Prasopora contigua* Ulrich. Ibid, p. 87).

Locality.—Cincinnati, O., and in Minnesota.

Remarks.—This species, while similar to the preceding, can be readily separated from it by the well-marked groups of

large corallites. In the form described as *Aspidopora parasitica* the species is occasionally parasitic, although even in this when the object to which the specimen is attached is small, the edges show a well-marked epitheca. We give below the main features of the two species given as synonyms. In the absence of illustrations reliance must be placed upon the descriptions.

Aspidopora parasitica Ulrich. Corallum adherent to foreign bodies, but showing when over-growing the foreign substance a wrinkled basal epitheca; corallites oval or circular, moderately thin-walled, and arranged more or less circularly about groups of cells larger than usual; interstitial cells numerous, but easily overlooked, on the surface; spiniform tubuli numerous and recognizable in well-preserved specimens; cystoid diaphragms in the larger cells, but horizontal, closely-set ones in the interstitial corallites; in tangential sections corallites sub-circular or oval, in contact at two, three or four points, interstitial cells occupying the intermediate spaces; spiniform tubuli at nearly all points of contact between the corallites.

Prasopora contigua Ulrich. Corallum hemispheric, base flat or concave, one-half to three-quarters, rarely one inch in diameter; cells polygonal and thin-walled, with groups of cells slightly larger than the average at intervals; interstitial cells hardly discernable at the surface, but observable in tangential sections, where they are wedged in between the larger cells; these last mostly in contact at their edges; spiniform tubuli also developed; diaphragms cystoid, more frequently excentric than central.

It is scarcely necessary to make any further remarks as to the relationship of these two "species" with *M. newberryi.*

7.—M. ELEGANS Ulrich, 1880.

Corallum free, thin, circular, from two lines to one and one-half inches in diameter, and about one-fourth of a line thick; upper side convex, lower concave, but specimens generally flattened by compression; under surface smooth, or with an epitheca having concentric or sometimes radiating striæ; upper surface with numerous, rather low, rounded tuberosi-

ties, the bases nearly or quite in contact; monticules arranged in diagonal, intersecting rows, and with an average diameter of two and one-half lines; calices diamond-shaped or hexagonal, gradually decreasing in size from $\frac{1}{60}$ inch in diameter at the summits, to $\frac{1}{110}$ inch in diameter in the interspaces; interstitial cells and spiniform tubuli absent; cell walls moderately thick, the cells arranged diagonally, but the regularity being slightly disturbed by the increasing size of the cells on the monticules; longitudinal sections show the cells proceeding to the surface with a slight inclination; walls of medium thickness; two or three diaphragms in each tube, on lines parallel with the upper surface; tangential sections show the cell walls are not fused. (Jour. Cin. Soc. Nat. Hist., vol. 2, 1880, p. 130, as *Chætetes elegans;* Ibid., as *Discotrypa elegans*, vol. 6, 1883, p. 164). (*Leptotrypa semipilaris* Ulrich, Geol. Sur. Illinois, vol. 8, 1890, p. 457).

Locality.—Cincinnati, O., and Covington, Ky.

Remarks.—This species is similar in many respects to the preceding, but differs in the low, broad monticules, and the variability in size and shape of the cells. It should also be compared with *M. areolata*, to which it bears a great resemblance. The species described by Mr. Ulrich as *Leptotrypa semipilaris* does not present enough points of difference to justify a separation from the present form, but in order to permit of comparison, the essential features of the species are given below.

Leptotrypa semipilaris Ulrich. Corallum small, discoid, lenticular or globose, usually hemispherical; surface smooth, or with low elevations with clusters of larger cells at the apices; corallites direct, thin-walled; calices subpolygonal, eight in two mm.; tabulæ usually wanting, but a few occasionally developed near the surface; spiniform corallites moderate in number and size, placed at angles of corallites.

8.—M. LENS McCoy, 1850.

Corallum discoidal, concavo-convex, the concavity of the base corresponding to the convexity of the upper surface; varying in size from less than one-fourth of an inch to one inch in diameter, and from one-half to about one line in

thickness; upper surface smooth and destitute of monticules, but occasional specimens with groups of calices slightly larger than the average; under surface, when unworn, covered with a delicate epitheca showing fine concentric lines and radiating striæ; cell apertures sub-circular, with thin walls when well preserved, but frequently appearing thick if worn, sometimes arranged in regular, slightly-curved rows, of from four to twelve or more, and seven or eight in one line; corallites somewhat bent or tortuous, tabulate, the smaller more closely than the larger ones; tabulæ mostly horizontal; in cross sections there are shown two kinds of tubes, the larger mostly circular, the smaller more numerous and varying in shape. (Ann. and Mag. Nat. Hist. 2d ser., vol. 6, Oct., 1850, p. 283, as *Nebulipora lens*). (*Fistulipora lens* Whitfield, Ann. Rept. Geol. Wisc., for 1877, p. 69; *Mont. circularis* James, Paleontologist, No. 6, Sept. 12, 1882, p. 46; *Calloporella harrisi* Ulrich, Jour. Cin. Soc. Nat. Hist., vol 6, 1883, p. 91.)

Locality.—Oxford, Blanchester, Westboro, and other places in Clinton, Warren and Butler counties, Ohio; Wisconsin; Wales.

Remarks.—This species is well characterized by its circular form and the regular arrangement of the cells in curved lines. The form has a wide distribution, for there can be scarcely a doubt but that the forms from Ohio are the same as those from Wales and Wisconsin. Ulrich's species does not differ in any essential character from *circularis* as defined by Mr. James, and that species is certainly the same as *lens* of McCoy, and *F. lens* of Whitfield.

9.—M. DUBIA Ulrich (sp.) 1890.

Corallum discoid; "upper surface with the usual style of cell aperture;" lower surface with an epitheca; corallites direct, circular, with slightly wavy walls; interstitial cells comparatively few and small, situated at the angles between the corallites; tabulæ horizontal and complete in both kinds of corallites, but more closely set in the small than in the large ones; spiniform tubuli wanting. (Geol. Sur. of Ills., vol. 8, 1890, p. 459, as *Diplotrypa? dubia*.)

Locality.—Wilmington, Illinois.

Remarks.— This is an unsatisfactorily-defined and poorly-illustrated species, and mainly for this reason it is placed here as a separate species. It occurs at Wilmington, Illinois, in connection with species known from Cincinnati, and for this reason and in the expectation of its occurrence in Ohio and Indiana, it is included in this MANUAL. It would, however, be difficult to recognize from the meager description given by its author.

10.— M. ARCOLATA Ulrich, 1883.

Corallum free, very thin, convex, three lines to one inch in diameter and two and a half lines thick, under surface with radiating striæ, or a few obscure concentric wrinkles; upper surface celluliferous and with a number of convex or irregularly angular spaces, .15 inches in average diameter; at the margin of these spaces the cell apertures are circular, $\frac{1}{110}$ of an inch in diameter and at the center they are $\frac{1}{80}$ inch in diameter; calices frequently closed by opercula; interstitial spaces with interstitial cells and numerous spiniform tubuli; in longitudinal sections the tubes are seen to be prostrate for about one half their length and then proceed direct to the surface; walls thin, more or less flexuous; interstitial tubes enlarge rapidly and attain their full diameter at the second diaphragm; in the proper tubes there are only two or three tabulæ and these in the lower part; in the interstitial tubes, however, the tabulæ are crowded; tangential sections show cells to have thin walls; interstitial spaces have large, usually hour-glass shaped cells, occasionally divided in halves by a faintly-defined wall; comparatively large spiniform tubuli developed in all parts where the true cells come into contact. (Jour. Cin. Soc. Nat. Hist., vol. 6, 1883, p. 164, as *Aspidopora arcolata.*) (*Diplotrypa patella* Ulrich, Geol. Sur. Illinois, vol. 8, 1890, p. 458.)

Locality.— Cincinnati and Oxford, Ohio.

Remarks.— This species is a very close ally of *M. elegans*, and in a previous paper by Mr. U. P. James and the author,* it was placed as a synonym of it. It seems best, however, in

*Jour. Cin. Soc. Nat. Hist., vol. 10, 1888, p. 165.

view of the presence here of interstitial tubes and spiniform tubuli, both of which are absent from *M. elegans*, to consider it as a distinct species. It might, perhaps, be more correctly referred to it as a variety. A new species, called by Mr. Ulrich *Diplotrypa patella*, does not seem separable. Its characters are as follows:

Diplotrypa patella; Corallum lenticular, 25 to 38 mm. in diameter and 2 to 4 mm. thick at the center; surface smooth, the spiniform corallites projecting above the edges of the calices; clusters of cells slightly larger than the average, but not elevated above the general level; under surface with a thin and concentrically wrinkled epitheca; corallites thin-walled, eight in two mm., calices circular or polygonal, normal ones .18 mm., but larger ones .25 mm. in diameter, arranged in diagonally intersecting series; interspaces occupied by spiniform corallites; tabulæ moderately abundant, straight or curved, especially in the lower part of the tube; tabulæ more numerous in the small than in the large corallites.

11.—M. CALYCULA (James) Nicholson, 1871.

Corallum free, forming a thin, circular, concavo-convex leaf-like expansion, $\frac{1}{60}$ inch thick, one-half to two inches in diameter; under surface generally deeply concave, covered with a thin epitheca, with fine radiating striæ and a few concentric wrinkles; upper surface with oval or circular calices, without monticules; corallites of two kinds, larger oval, rarely in contact, the smaller variable in size and shape, more or less angular and wedged in between the larger ones; spiniform corallites numerous, thick-walled, mostly situated at points where the larger calices should come into contact; tabulæ wanting or incomplete (?) in the large, but numerous, closely set, horizontal and complete in the smaller ones. (Cat. Foss. Cin. Gr., 1871 (named). Ibid, 1875, p. 1, as *Chætetes? calycula*; Nicholson, Genus Montic., 1881, p. 165.)

Locality.—Cincinnati, Ohio.

Remarks.—This species is somewhat similar to the preceding, but differs from it in having the edge of the corallum thin, and sharp and often irregular instead of being regular and thickened. Many specimens are found with the cell-

bearing surface buried and the basal surface exposed. The description above given is that of Nicholson.

12.—M. ECCENTRICA James, 1882.

Corallum plano- or slightly concavo-convex, sub-circular, small, from one to two lines in diameter, and one-half a line, or less, thick; under surface often exposed in specimens imbedded in the rock, flat or slightly concave; epitheca thin, with fine concentric lines, having a starting point near one margin; fine lines also radiate from the eccentric starting point to the margin; bases of corallites easily seen through the epitheca; upper surface gently convex, smooth; calices circular, similar in size, with a few of the central ones slightly larger than the others; walls thin; interstitial corallites few or numerous; cross section shows oval tubes with somewhat thickened walls, distinctly separated, the interspaces occupied by curved or angular lines; corallites curving slightly at the base, then taking an oblique course to the surface; tabulæ horizontal in the small, but mostly oblique in the larger tubes. (The Paleontologist, No. 6, Sept. 12, 1882, p. 48.)

Locality.—Cincinnati, O.

Remarks.—This species can be readily recognized by its small size, and by the eccentric radiation of the striæ on the epithecal membrane. It is possible that these peculiarly-arranged striæ are due to the growth of the coral upon the shell of *Schizocrania filosa.* Should this actually prove to be the case, the species would better be considered the same as *M. lens*, or possibly be placed as a variety of that species.

13.—M. FALESI James, 1884.

Corallum free, oval or round; the upper surface low and convex in the oval specimens, and steep and conical, with a small apex in the round ones; varying in size from about one-half to three-quarters of an inch in diameter, and from one-quarter to three-quarters of an inch high; margins thin and sharp; under surface peculiar in possessing a regularly-outlined conical groove, extending nearly across the middle

of the longest diameter, and with a pointed end, the concave surface of the groove covered with fine transverse striæ; calices circular and polygonal; stellate maculæ distributed irregularly over the surface, little or not at all elevated, and sub-solid, or with a larger cell in the center; walls of cells thin; interstitial cells and spiniform corallites few; seven or eight calices to one-tenth inch between the maculæ, but fewer in number on the maculæ; corallites thin-walled, with a direct course from the base to the upper surface; tabulæ closely set with, in some cases, a series of vesicles attached to one side of the tube, and extending half way across, being met by horizontal tabulæ from the other side; corallites circular, with a curved line from side to side, giving a crescentric appearance. (Jour. Cin. Soc. Nat. Hist., vol. 7, 1884, p. 138.)

Locality.—Danville and Frankfort, Ky.

Remarks.—This species, characterized mainly upon the presence of the conical groove on the under surface, is abundant in beds of Trenton age at Frankfort, Ky., and in upper beds of the Cincinnati Group at Danville, Ky. It is possible that it may prove to be the form described by Nicholson as *selwynii* var. *hospitalis*. This is stated to occur at Waynesville, and to be parasitic upon shells of brachiopods. The internal structure, especially the vesicles on one side and straight tabulæ on the opposite, is the same in both forms. That described as *falesi*, however, seems to be made up of tubes of one size only; the other has both large and small corallites. The conical groove is probably produced by the growth of the coral upon a species of *Hyolithes*, although some have considered it to be the small end of an *Orthoceras* or *Endoceras*.

14.—M. PETASIFORMIS Nicholson, 1881.

Corallum free, conical or discoidal, varying in size from one-half inch to nearly two inches in diameter, and also variable in shape; under surface flat or concave, covered with a concentrically striated epitheca; corallites springing upward, at right angles to the base, and giving rise to an expansion thin at the edges, and elevated in the center from one-half an inch

to an inch above the base; sometimes two elevations are present: calices thin-walled, polygonal, nearly equal in size; scattered over the surface are clusters of slightly larger cells, either even with the surface or raised slightly above it; interstitial cells none; tabulæ numerous, complete, well developed throughout the entire length of the corallum. (Genus Montic., 1881, p. 190.)

Locality.— Cincinnati, Ohio.

Remarks.— This is one of the numerous perplexing forms which, while externally similar to others, differs materially in internal structure. It is one of the forms that has been called *petropolitanus.*

var. WELCHI James, 1882.

This variety has the same general mode of growth as the typical form: the monticules are much more pronounced, and the central portions are occupied by from four to ten or more small pores, the larger calices surrounding or being mingled with these; maculæ sometimes form conspicuous monticules, irregularly arranged and from one to two lines apart; interstitial cells rarely found scattered among the calices covering the general surface; one peculiar feature is to be found in certain projections, either straight or branching, which spring from the upper surface of the corallum; internal structure similar to type form. (*M. welchi* James. The Paleontologist, No. 6, Sept. 12, 1882, p. 50.)

Locality.— Cincinnati, Ohio.

Remarks.— In the original description it is stated that this may be only a variety, as it is here considered. Two points of difference are noticed, one in the presence of a few interstitial corallites and the other in the monticules. These are scarcely sufficient to warrant specific rank. The largest example observed was three inches in diameter. Broken off projections present various forms, being cylindrical, lobate, flattened or irregular in outline.

15.— M. WHITEAVESII Nicholson, 1881.

Corallum discoid when young, hemispheric when adult, often with wide margins; varying in size from one-half inch

to one and one-quarter inches in diameter, and from two to six lines or more high; under surface with a concentrically wrinkled epitheca, generally deeply concave, but sometimes flat; upper surface with scattered and very slightly raised monticules, composed of corallites slightly above the average size; corallites directed at nearly right angles to the entire basal plate, to the upper surface, and of two kinds, large and small, and both intermingled; large tubes more or less thin-walled, angular, sub-angular, or hexagonal, sometimes in groups of four or five each; small corallites very numerous and variable in size and form, always thin-walled and angular, filling the spaces between the larger tubes; spiniform corallites at the angles of junction of the cells; in internal sections all the tubes except the spiniform corallites equally thin-walled, the large corallites crossed by remote, horizontal and complete tabulæ, the smaller ones by similar but more closely set tabulæ. (Pal. Tab. Corals, 1879, pl. XIII, fig. 4,4 *b*; Genus Montic., 1881, p. 160.)

Locality.— Warren and Clinton Counties, Ohio.

Remarks.— This is one of the numerous forms that have been referred to *petropolitanus* Pander, and it is puzzling because of the similarity in external form to several other species. In an article published in 1888,* by U. P. and J. F. James, the species described by Nicholson as *M. selwynii* was placed as a synonym of the present form. The internal structure of the two is different, so that it seems best to separate them. *M. selwynii* itself does not seem to occur at Cincinnati, but a variety of it does. This will be referred to later on.

16.— M. CINCINNATIENSIS James, 1875.

Corallum either free or attached, forming a layer a line or less thick; under surface with a strongly-wrinkled epitheca, not often seen; upper surface covered with numerous conical and very prominent monticules, the bases of which are close together; calices sub-polygonal, moderately thick walled, with a number of interstitial cells; corallites of two kinds; the larger generally oval or circular, the smaller variable in shape, but more or less angular; vertical sections show the

*Jour. Cin. Soc. Nat. Hist., vol. 10, Jan., 1888, p. 169.

larger corallites to have horizontal and complete tabulæ and also a series of incomplete tabulæ forming a series of vesicles along one side of the tube; small corallites with numerous complete and horizontal tabulæ. (Cat. Low. Sil. Fossils, 1875, p. 2, as *Chætetes cincinnatiensis;* Nicholson, Genus Montic., 1881, p. 226). (*M. consimilis* Ulrich, Jour. Cin. Soc. Nat. Hist., vol. 5, Dec., 1882, p. 238. *Prasopora nodosa* Ulrich. Ibid, p. 245).

Locality.—Cincinnati and Oxford, O.; also, Trenton group at Nashville, Tenn.

Remarks.—This is a well-marked species, especially distinguished by the prominent, conical monticules. Of the two species placed as synonyms only a single fragment was found of the first; and although the second was from a lower horizon (upper Trenton, of Tennessee), there does not seem any reason for separating it as a distinct species. The two species are described below for comparison.

M. consimilis. Corallum attached to shell of a *Strophomena*, the upper surface with unequally distributed, compressed and prominent monticules, the summits occupied by apertures of small cells and the slopes by cells larger than the average; ordinary cells thin-walled, polygonal, $\frac{1}{110}$ to $\frac{1}{120}$ inch in diameter; longitudinal sections show in the immature portion, thin-walled cells, crossed by straight or oblique tabulæ, with a few vesicles in the larger cells; in the mature portions the walls are thicker, and both straight tabulæ and vesicles are more numerous; transverse sections show polygonal and thin-walled cells, the visceral chamber being crossed by delicate laminæ excavated on one side in a crescentric or triangular manner, exactly as in *cincinnatiensis.*

Prasopora nodosa Ulrich. Corallum small, irregular or hemispherical, one to one and one-half inches in diameter; lower surface lined with a wrinkled epitheca; upper convex, covered by prominent, closely-arranged but usually unequal monticules; calices sub-circular, walls thin, varying from $\frac{1}{120}$ to $\frac{1}{110}$ inch in diameter; angular, interstitial cells frequently present; internally made up of two kinds of corallites, the larger with thin, distinct walls, oval or sub-circular, $\frac{1}{120}$ inch in diameter and only in contact at certain points; tabulæ straight and forming vesicles along one side of the

tubes; interstitial cells numerous, having many closely set, horizontal tabulæ; a few spiniform corallites may be observed in tangential sections.

GROUP III. *Dendroid or Ramose;* Branching more or less; stems cylindrical or sub-cylindrical; base free or attached; calices covering the branches, varying in form; monticules present or absent.

I. Surface smooth.

a. calices oval or circular; all similar.
* apertures of calices thick.................... 17
* apertures oblique; lips thin.................. 18

b. calices oval or circular; interstitial cells present.
* apertures oblique; lips thick 19
* maculæ present, with larger cells than average, 20
* larger cells separated by number of small ones, 21
maculæ present; made of larger cells, and occupied also by minute cells..............22, 23, 24
* calices surrounded by ring-like wall 25

c. calices rhomboidal; arranged in lines................ 26

d. calices irregular in form 27, 28

II. Surface with maculæ or low monticules.

a. calices polygonal or sub-polygonal.
* clusters of cells larger than average; interstitial cells few.............................. 29
* cluster of cells smaller than average; interstitial cells numerous 30
* low monticules present; interstitial cells present....................................... 31
† no interstitial cells.......... ....32, 33

b. calices oval or circular.
* maculæ or monticules formed of smaller cells. 34

III. Surface with conspicuous monticules.

a. calices of two kinds; monticules elongated or conical.
* calices large, sub-polygonal.................. 35
* calices large, oval............................ 36
* calices ovate or sub-circular.................. 37

b. calices of two kinds; monticules conspicuous, arranged in alternate manner..................... 38

c. calices sub-equal; monticules small, arranged in alternate manner..............................39, 40

17.—M. BRIAREA Nicholson, 1875.

Corallum free, dendroid, beginning with a pointed base and expanding above; branches variable in number, two and one-half to four lines in diameter, cylindrical, possibly branching more than once; surface smooth; calices of one kind only, oval or circular; walls of corallites thick at the surface; interstitial tubes and spiniform corallites wanting; in the axial region the corallites are thin-walled and polygonal; tabulæ complete and horizontal in both axial and peripheral regions, but most numerous at the point where the corallites bend outward toward the surface; tangential sections show corallites to be uniform in size and of one kind only; axial sections show thin-walled and polygonal corallites, the walls beginning to thicken when curving outward. (Pal. of Ohio, vol. 2, 1875, p. 202; Nich., Genus Montic., 1881, p. 198.)

Locality.—Cincinnati, O., and Frankfort, Ky.

Remarks.—This is one of the best marked species of the genus. It has an apparently free, pointed base, and branches in a digitate manner. The ordinary specimens are from one and one-half to two inches long, but specimens may attain a length of six inches. Specimens from near Frankfort, Ky., present all the characters of the Ohio form, and occur either in the lowest beds of the Cincinnati rocks or in the topmost layer of the Trenton.

18.—M. GRACILIS (James) Nicholson, 1874.

Corallum dendroid, branches cylindrical or sub-cylindrical, from less than one line to three lines or more in diameter, branching at intervals; surface smooth; calices oval, their long axes corresponding with the long axis of the branch, opening obliquely; cell mouths greatly thickened; interstitial tubes moderate in number; spiniform corallites present, but mainly to be detected by microscopic sections; in the axial region corallites vertical, thin-walled and polygonal with few or no tabulæ; as they bend outward toward the surface the walls become greatly thickened, and the tabulæ are more numerous, in all cases being horizontal and complete; three distinct types of corallites are to be recognized;

the normal ones with a diameter of $\frac{1}{143}$ of an inch or less, with a moderate number of horizontal tabulæ; smaller corallites intercalated with the normal ones and with more numerous and more closely set tabulæ; and a small number of spiniform corallites situated in the thick walls separating the normal corallites. (Cat. Fos. Cin. Gr., 1871 (name only). Nicholson, Quart. Jour. Geol. Soc. Lond., vol. 30, 1874, p. 504, as *Chætetes.* Genus Montic., 1881, p. 125.)

Locality.—Cincinnati, O.

Remarks.—Dr. Nicholson considers this, and the one following, to be the same. Although closely allied, the smaller form, the oblique openings of the calices, and the absence of maculæ, serve to distinguish the two.

17.—M. MEEKI James, 1878.

Corallum dendroid, free (?), generally branching irregularly, often but once, and having in these specimens a Y-like form; the branches from less than two lines to over six lines in diameter, often hollow, compressed, and filled with clay; surface smooth, with stellate maculæ, very slightly or not at all raised above the surface; calices sub-equal, polygonal, or sub-circular, slightly larger in the maculæ; walls thick, not spinous; corallites in the axial region thin-walled and polygonal, with few tabulæ; as they bend outward toward the surface the walls become thickened, and the tabulæ are more numerous; in all cases complete and horizontal; smaller corallites intercalated between the large ones, and having more numerous and more closely-set tabulæ. (The Paleontologist, No. 1, July 2, 1878, p. 1, as *Chætetes*; Ibid., No. 5, June 10, 1881, p. 35.) (*Amplexopora cingulata* Ulrich, Jour. Cin. Soc. Nat. Hist., vol. 5, Dec., 1882, p. 254; *A. robusta* Ulr., Ibid., vol. 6, 1883, p. 82.)

Locality.—Oxford, Clinton and Warren counties, O.; *Amplexopora cingulata* at McKinney's Station, C. S. R. R., Ky.

Remarks.—This form is distinguished from *M. gracilis* by its more robust habit, and the presence of maculæ of larger cells than the average. Dr. Nicholson, basing his opinion upon the internal structure, which he says is exactly like *M. gracilis*, considers it to be only a variety of that species. The

two forms described by Ulrich as *Amplexopora cingulata* and *A. robustata* seem to be only this species. The following notes enable the student to judge:

Amplexopora cingulata Ulrich. Corallum ramose, dividing dichotomously at irregular intervals; branches cylindrical or sub-cylindrical; varying from three to seven lines in diameter; surface smooth and destitute of monticules, but with groups of from seven to fifteen cells, slightly larger than the average, varying from $\frac{1}{80}$ to $\frac{1}{60}$ inch in diameter, the ordinary cells being $\frac{1}{90}$ inch in diameter; calices, when well preserved, sub-polygonal, with moderately thin walls and with small granules; but, as usually found, calices rounded and walls comparatively thick and smooth; in tangential section cells of one kind only; original polygonal walls readily recognized, but the internal cavities more or less rounded by secondary deposits of sclerenchyma; line of junction between walls occupied by numerous small spiniform tubuli; longitudinal sections show corallites with remote horizontal tabulæ, and thin walls in the axial region, but as they approach the surface, the walls become thickened and the tabulæ are more numerous; a few funnel-shaped tabulæ occur in some of the tubes. Beyond having more numerous funnel-shaped tabulæ, more conspicuous spiniform tubuli, and slightly thicker walls *A. robusta* is identical with *A. cingulata*. It would be a difficult matter indeed to separate a large suite of specimens upon these characters; and while, *perhaps*, they might merit varietal rank, they should not, according to our views, be regarded as sufficient to constitute distinct species.

20.—M. AFFINIS Ulrich (sp.), 1890.

Corallum irregularly dendroid, seldom branching, fifteen mm. thick; surface smooth, with hardly-appreciable clusters of cells slightly larger than the average; apertures sub-polygonal; corallites polygonal, thin-walled; tabulæ complete and horizontal, twice as numerous in the small as in the large cells and with a few infundibular tabulæ scattered promiscuously; spiniform tubuli conspicuous, usually between the corallites, occasionally situated at the angles. (Geol. Sur. Illinois, vol. 8, 1890, p. 450, as *Amplexopora affinis*.)

Locality.—Wilmington, Illinois.

Remarks.— The species is described as occurring in Illinois in beds of the same age as those at Cincinnati, and it is inserted here on that account. It presents many features of resemblance to both the preceding and the following species, but in the present state of knowledge it is considered best to regard it as distinct.

21.— M. O'NEALLI James, 1875.

Corallum dendroid, branching dichotomously, branches varying from less than one line to two lines in diameter; surface smooth, calices generally oval, long axes corresponding to the long axes of the branches; of two kinds, the larger separated by a considerable number of interstitial tubes; walls thickened at cell mouths; operculæ often closing apertures of cells; corallites in the axial region polygonal and thin-walled, bending outward with an exceptionally gradual inclination; complete, horizontal tabulæ either absent or very sparingly developed in the central region, but present in moderate numbers in the outer thickened-walled region; small interstitial corallites more closely tabulate than the large ones; "in some cases a few of the tabulæ in the throat of the large tubes may become so bent as to unite with one another, and to form a small number of lenticular vesicles in this region." (Nicholson, Genus Montic., p. 120.) (Cat. Foss. Cin. Group, 1875, p. 2, as *Chætetes? o'nealli.*) (*Chætetes sigillaroides*, Nicholson. Pal. of Ohio, vol. 2, 1875, p. 203; Genus Montic., 1881, p. 120.)

Locality.— Cincinnati, Ohio.

Remarks.— This species has a peculiar habit of growth, branching at almost every possible angle, and anastomosing so as to form various figures. It also has a considerable number of interstitial corallites among the normal ones. *Chætetes sigillaroides* is undoubtedly a synonym, although it is retained as a species by some authors.

22.— M. SIMULATRIX Ulrich (sp.), 1890.

Corallum dendroid, with cylindrical branches 2 to 5 mm. in diameter; surface smooth, with clusters of cells not at all

or but slightly elevated; apertures wider and the interstitial cells more numerous in the spaces than elsewhere; apertures oval, 0.2 mm. long and about eight in the space of 2 mm.; corallites somewhat irregular in their course in the axial region, where the walls are considerably thickened; tabulæ complete and horizontal, few in number, but more numerous in the small than in the large cells; spiniform tubuli very small. (Geol. Sur. Illinois, vol. 8, 1890, p. 432, as *Batostomella simulatrix*.)

Locality.— Various points in Ohio and Indiana. Illinois.

23.— M. COMMUNIS U. P. and J. F. James, 1888.

Corallum dendroid, but as generally found, much broken. the cylindrical or sub-cylindrical stems from one to three lines in diameter, branching at variable distances at acute angles, but masses of considerable size—from one inch to six or eight inches or more in diameter — sometimes found, in which the stems anastomose in a very irregular manner; the surface of most specimens with maculæ or monticules, raised little or not at all above the surface, occupied by calices much larger than the average, and sometimes clusters of smaller tubules; calices oval or sub-circular, occasionally somewhat angular; interstitial corallites numerous, occasionally nearly or quite surrounding the larger cells, and of various shapes; about six calices in the space of one line in the longitudinal direction of the stem, and seven or eight transversely; cell walls thin at the surface of unworn specimens, but thickened immediately below; longitudinal sections show the walls of corallites in the axial region to be thin, becoming thicker at the surface and opening obliquely; tabulæ remote in the axial region, but more numerous near the surface, depressed or bent in the middle or oblique; the smaller tubes more closely tabulate; transverse sections show corallites to be circular or angular and with cruciform dissepiments; interstitial pores variable in shape; in tangential section corallites oval or sub-circular, walls much thickened and "distinctly defined by a dividing space." (Jour. Cin. Soc. Nat. Hist., vol. 10, 1888, p. 175). (*M. o'ncalli?* var. *communis* James. The Paleontologist, No. 6, Sept. 12, 1882, p. 47; *Callopora*

subplana, Ulrich. Jour. Cin. Soc. Nat. Hist., vol. 5, 1883, p. 253).

Locality.—Cincinnati, O., Covington, Ky., etc.

Remarks.—As noted above this species was originally considered a variety of *M. o'nealli*, but it was afterward raised to the rank of a species. Some of the distinguishing features are the larger calices in the maculæ, the greater number of interstitial corallites and the much more robust mode of growth. Mr. Ulrich's species, *subplana*, seems to be the same as *communis*, and for comparison the main features of his description are given below.

Callopora subplana Ulrich. Corallum ramose, branches cylindrical, from two to five lines in diameter and dividing dichotomously at intervals of six lines to one inch; surface showing clusters of from four to eight cells larger than the rest and often raised above the general surface; calices polygonal when unworn; but sub-polygonal or rounded when worn; interstitial cells few, most numerous between the large cells of the maculæ; longitudinal sections show the corallites in the axial region to have very thin, crimped and flexuous walls; tabulæ here are few but become more numerous toward the surface, where also the walls are thickened and interstitial tubes make their appearance; tabulæ in these last always complete and crowded; in tangential sections corallites rounded or oval with thickened walls; walls fused so the boundary can not be detected, but the cavity of the tubes surrounded by a secondary deposit of concentrically laminated sclerenchyma, the original wall represented by sclerenchyma of a lighter color; interstitial cells variable in size and shape, less numerous than the proper corallites.

24.—M. IMPERFECTUM Ulrich (sp.), 1890.

Corallum dendroid, branches sub-cylindrical, robust, 20 mm. or more in thickness, dividing at short intervals; surface marked with very slightly elevated aggregations of larger cells surrounding a cluster of smaller cells; calices subcircular; corallites with thin walls, very little thickened in the peripheral region; sub-polygonal; interstitial cells few,

usually in clusters in the center of a group of larger-sized corallites; tabulæ occurring throughout the corallites, incomplete or complete; the former in the mature portion of the corallum, the latter in the axial region; the incomplete tabulæ rarely extending more than one-half way across the tube; spiniform tubuli (?) very small. (Geol. Sur. Illinois, vol. 8, 1890, p. 460, as *Batostoma imperfectum.*)

Locality.—Wilmington, Ills.

Remarks —Externally this species is like the previous form, but it is one of those that externally alike is internally different, this difference consisting principally in the imperfect tabulæ.

25.—M. JAMESI Nicholson, 1874.

Corallum dendroid, branching irregularly or dichotomously, sometimes terminating in rounded ends, branches varying from two to five lines in diameter; surface smooth or nearly so; calices oval or rounded, sometimes indented on one or more sides, thick-walled, surrounded by a ring-like wall; intercellular spaces solid, or with a variable number of small tubes, or with blunt spines, apparently the solid apices of the interstitial cells; large corallites angular, polygonal and thin-walled in the center of the branches; becoming thickened as they approach the surface, each one in the outer portion of the branches surrounded by a distinct, ring-like wall; small interstitial corallites variable in size and shape, occupying the entire interval between the large ones; numerous spiniform tubuli also developed; tabulæ wanting or very sparsely developed in the axes of the branches; remote in the larger corallites but numerous and closely set in the smaller ones, always complete and horizontal or slightly bent. (Quart. Jour. Geol. Soc. Lond., vol. 30, 1874, p. 506, as *Chætetes jamesi*: Genus Montic., 1881, p. 143.) (*M. implicata* (Ulrich) Nicholson, Genus Montic., 1881, p. 147.)

Locality.—Cincinnati, Ohio.

Remarks.—The peculiarly-indented walls and the rings surrounding the apertures are marks of this species. *M. implicata* does not seem to differ in any essential characters, and it is therefore regarded as a synonym. Its main features are given below:

M. implicata (Ulrich) Nicholson. Corallum dendroid, stems flattened, three lines wide and one and a half to two lines thick, branching at intervals; calices $\frac{1}{80}$ to $\frac{1}{70}$ inch in diameter, irregularly oval, often indented on one or both sides, thick-walled with numerous blunt spines; between the ordinary calices are occasional smaller apertures; average corallites thin-walled in the central region, but becoming greatly thickened as they approach the surface, the original lines of demarkation between the tubes never being entirely obscured; small corallites developed in variable numbers; numerous circular, hollow tubes interspersed in the thickness of the walls and at the angles of junction of the cells; remote, complete and approximately horizontal tabulæ, somewhat more numerous in the small than in the large corallites.

26.— M. QUADRATA Rominger, 1866.

Corallum dendroid, occasionally sub-massive, branches cylindrical, varying from two to five lines in diameter, often ending in bulbous extremities; surface smooth or nearly so; corallites thin-walled below, slightly thickened toward the mouths, all similar; calices in places obliquely rhomboidal, sometimes polygonal, arranged in regular diagonal rows, the direction changing at short intervals; lips very thin; no interstitial tubes; tabulæ nearly wanting or very sparingly developed in the axial region, but a moderate number present in the outer portions of the corallites; tabulation in all the tubes alike horizontal and complete. (*Chætetes quadratus* Rom., Proc. Phila. Acad. Nat. Sci., 1866, p. 115.) (*Chætetes rhombicus* Nicholson, Quart. Jour. Geol. Soc. Lond., vol. 30, 1874, p. 507.) (Nicholson, Genus Montic., 1881, p. 179.)

Locality.—Warren and Clinton counties, Ohio.

Remarks.—This is one of the best marked species of the genus, the peculiar rhombic form of the cells serving to distinguish even a small fragment of it. Even when weathered, especially at the ends of the branches, it is immediately recognized. The diagonally-curved arrangement of the calices is another well-marked feature.

Var. SUBQUADRATA Ulrich, 1882.

Differs from the type mainly in its smaller size, the branches being from one to two lines in diameter. There are also a small number of interstitial corallites occasionally found. Otherwise as in the type. (*Monotrypella subquadrata* Ulrich, Jour. Cin. Soc. Nat. Hist., vol 5, 1882, p. 249.)

Locality.—Osgood, Ind.; Blanchester, Westboro, Jackson, etc., Ohio.

Remarks.—This form we have previously regarded as the same as *M. quaarata*,* but in view of the presence of interstitial corallites and the smaller size, it has been thought best to regard it as a variety. It is, of course, possible that it may represent the smaller branches of the typical *M. quadrata.*

27.—M. VARIANS James, 1878.

Corallum variable in form, ramose, incrusting or massive; in the ramose forms, branches irregular, rounded or sub-cylindrical, digitate; the massive forms irregular, contorted, flattened or lobate, four or five inches in diameter, throwing out shoots in various directions; frondose and celluliferous on both sides; surface smooth; calices sub-circular, oval, or polygonal; walls thick; interstitial cells few to numerous; longitudinal sections show the corallites to be thin-walled in the axial region, but becoming thickened at the surface; tabulæ remote, horizontal and complete, those in the interstitial cells not more numerous than in the normal corallites; tangential sections show thin-walled polygonal cells, with an occasional interstitial cell at the junction of two or more larger ones. (The Paleontologist, No. 1, July 2, 1878, p. 2. as *Chætetes;* Ibid., No. 5, June 10, 1881, p. 36.) (*Batostoma variable* Ulrich, Geol. Sur. Ill., vol. 8, 1890, p. 460.)

Locality.—Blanchester and Clarksvllle, Ohio; Illinois, and Wisconsin.

Remarks.—This is a variable species, as far as its mode of growth is concerned. The incrusting forms may be young corallums. The species described under the name of *Bastostoma variabile* is undoubtedly the same as *M. varians* James.

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* Jour. Cin. Soc. Nat. Hist., vol. 10, 1888, p. 177.

Both figures and description show this. The description is as follows:

Batostoma variabile Ulrich. Corallum variable, encrusting, lobate, digitate, ramose and sub-frondescent; surface smooth, showing slightly elevated clusters of larger shells; calices angular; walls of corallites in axial region thin, faintly and irregularly flexuous; corallites polygonal, approaching the surface in a gradual curve and mainly in contact, the divisional lines between those adjoining sharply marked; interstitial cells angular, varying in number; tabulæ few in the axial region, three or four in the cortical region, one or two nearest the surface concave; more numerous in the interstitial cells and in all cases complete; spiniform tubuli fairly numerous, usually situated at the angles between the corallites.

28.—M. WHITFIELDI James, 1881.

Corallum dendroid, variable, very irregularly branched, the branches either close together or some distance apart; often rounded at the ends, sometimes swollen or flattened as if hollow; varying from 1/8 to 3/4 of an inch in diameter; surface smooth; calices variable in size and form, polygonal, oval, circular, pentagonal, etc.; five to eight in the space of one line; sometimes groups of calices larger than the average scattered irregularly over the surface; also groups of from six to ten small interstitial tubes; walls of corallites thin; longitudinal sections show walls to be transversely wrinkled, and more or less sinuous horizontally; tabulæ few and at variable distances apart; corallites growing in a longitudinal direction, then bending and opening obliquely at the surface. (The Paleontologist, No. 5, June 10, 1881, p. 34.)

Locality.—Cincinnati, O.

29.—M. ANDREWSII Nicholson, 1881.

Corallum variable, but generally dendroid, branches subcylindrical, two to six lines in diameter, flattened, expanded or inosculating; surface with clusters of from five to seven cells slightly larger than the average, and though elevated, yet not enough to form monticules; calices polygonal or sub-

polygonal, separated by a moderate number of smaller interstitial tubes, developed principally at the angles of junction of corallites; corallites in the center of the branches thin-walled and polygonal, the walls becoming much thickened as the tubes bend outward, and becoming amalgamated with one another; no spiniform tubuli; tabulæ always complete and horizontal, well developed in all the corallites, and throughout their whole extent; small corallites much more closely tabulate than the large ones. (Genus Montic., 1881, p. 128.) (*Chætetes pulchellus* Nich., *non* Edw. & Haime, Quart. Jour. Geol. Soc. Lond., vol. 30, 1874, p. 503; *Monotrypella æqualis* Ulrich, Jour. Cin. Soc. Nat. Hist., vol. 5, 1882, p. 247.)

Locality.—Cincinnati, O.

Remarks.—As noted above, this species was originally referred to as *Chætetes pulchellus*, although afterward described as distinct. *Monotrypella æqualis*, placed here as a synonym, seems to have but one character in which it differs from *andrewsi*. This is in the absence of tabulæ from the central region of the branches. In order to compare the two forms the following description is given:

Monotrypella æqualis Ulrich. Corallum irregularly ramose, the branches cylindrical or compressed, two to five lines in diameter; surface often smooth, but sometimes with low, rounded monticules, occupied by clusters of large cells $\frac{1}{55}$ of an inch in diameter; ordinary cells thin-walled, polygonal, about $\frac{1}{90}$ inch in diameter; a few cells slightly larger than the average occasionally observed among the cells of the monticules; tangential sections show tubes to be regularly polygonal, moderately thick-walled, and in contact with each other on all sides; the line of demarkation between the tubes may be distinct or nearly wanting; walls thickened at the angles, appearing like spiniform tubuli; tabulæ in the axial region wanting or remote, but in the peripheral region closely set or crowded, all straight or horizontal.

30.—M. ULRICHII Nicholson, 1881.

Corallum ramose, of cylindrical or sub-cylindrical branches, dividing at irregular intervals, and from less than two lines

to about four lines in diameter; surface smooth; calices subpolygonal or rounded; walls of corallites thickened; interstitial corallites numerous, angular, interspersed with the ordinary corallites; corallites at first with thin walls, but these becoming thickened in the outer part of their course, the walls also seemingly becoming fused together; spaces between the corallites occupied by interstitial corallites, and spiniform tubuli developed at the angles of junction of the normal cells; tabulæ wanting or very sparingly developed in the axial region, but more abundant in the outer zone; more closely set in the small than in the large corallites, and complete and horizontal in all cases. (Genus Montic., 1881, p. 131.) (*Chætetes fletcheri* Nicholson, Quart. Jour. Geol. Soc. Lond., vol. 30, 1874, p. 504; *Dekayella obscura* Ulrich, Jour. Cin. Soc. Nat. Hist., vol. 6, 1883, p. 89.)

Locality.—Cincinnati, O.

Remarks.—Externally this species is similar to *M. andrewsii*, but that is generally more robust and has fewer interstitial corallites. That form also shows maculæ of corallites larger than the average, while in the present species maculæ, if developed, are made up of smaller corallites than the average. Mr. Ulrich's species, *Dekayella obscura*, presents too few points of difference to be separated, and it is not necessary to give them here.

31.—M. gelasinosa Ulrich (sp.), 1890.

Corallum dendroid, branches about 4 mm. in thickness; surface marked with conspicuous, elongated, parallel, dimple-like maculæ, arranged in transverse rows; calices subangular, about ten in 2 mm., those on the borders of the maculæ about one-half larger; interstitial tubes angular, comparatively large and shallow, occurring only in the maculæ; walls of corallites thin, flexuous or wavy in the axial region, moderately thickened near the surface; horizontal and complete tabulæ occasionally present in the axial region, but these changing to vesicles in the peripheral region; spiniform tubuli at the angles of the corallites; tubulæ in the small corallites horizontal and complete. (Geol. Sur. Illinois, vol. 8, 1890, p. 410, as *Homotrypa gelasinosa*.)

Locality.—Wilmington, Ills.

Remarks.—This is another one of the species found in rocks of the Cincinnati Group in Illinois, which has so far not been recorded from our region. The peculiarly-arranged and conspicuous maculæ form a readily distinguishing mark, and this feature, in connection with the peculiar tabulation of the corallites, would seem to make the species easily recognizable.

32.—M. SEPTOSA Ulrich, 1879.

Corallum ramose; branches cylindrical or sub-cylindrical; surface with broad, low monticules, about one line apart and occupied by groups of cells larger than the average; calices polygonal, rather regularly arranged; walls of corallites thin; no interstitial corallites; worn specimens show peculiar projections from the cell walls into the cell cavity; longitudinal sections show the corallites to be nearly vertical in the center of the branch, where they have very thin walls and are crossed by very thin and remote tabulæ; they then bend outward, and as the surface is reached the walls are thicker and the tabulæ more numerous; pseudo-septa are conspicuous in tangential sections, three or four in each corallite. (Jour. Cin. Soc. Nat. Hist., vol. 2, p. 125, as *Atactopora septosa*; Ibid., vol. 5, 1882, p. 255, as *Amplexopora septosa*.)

Locality.— Cincinnati, Ohio.

33.—M. KENTUCKENSIS James, 1883.

Corallum dendroid; branches cylindrical; about one line, more or less, in diameter, branching dichotomously or anastomosing; surface with low monticules irregularly distributed; calices polygonal, of various forms and sizes; walls comparatively thick at apertures; no interstitial pores; longitudinal sections show corallites in the center of the branch diverging slightly from a longitudinal direction, the inclination increasing toward the surface, some corallites opening obliquely, some at right angles to their course; in some cases the walls bifurcate, forming tubes with pointed bases and with apertures of the normal size; walls comparatively thick throughout; tabulæ numerous in all parts of the corallites;

tangential sections show thick-walled, angular cells, variable in size, and with an occasional spiniform corallite. (The Paleontologist, No. 7, April 16, 1883, p. 57.)

Locality.— Paris, Ky.

34.— M. SUBPULCHELLA Nicholson, 1875.

Corallum dendroid; branches compressed or flattened, sometimes partially hollow; surface nearly smooth, having somewhat stellate maculæ, scarcely elevated, and about a line apart, made up of smaller corallites than the average; calices large and small, all with moderately thick walls, the larger surrounding the maculæ of smaller cells; larger calices circular or polygonal; small ones sub-angular; spiniform corallites few; corallites thin-walled in the central region, becoming thicker toward the surface and the walls seemingly fused together; complete horizontal tabulæ developed in all parts of the corallum, but much more numerous in the thickened peripheral portion than elsewhere; interstitial tubes more closely tabulate than the large ones. (*Chætetes subpulchella* Nicholson, Pal. of Ohio, vol. 2, 1875, p. 196; Genus Montic., 1881, p. 134.)

Locality.— Cincinnati, Ohio.

Remarks.— This species is to be mainly distinguished from other dendroid forms by the star-shaped maculæ, made up of smaller cells than the average, and thickly scattered over the surface of the flattened, sub-frondose branches.

35.—M. RAMOSA D'Orbigny, 1850.

Corallum dendroid, branches cylindrical or elliptical, dividing dichotomously, varying from one to three or four lines in diameter; surface with numerous conical or slightly-elongated monticules, at intervals of one-half a line to one line apart, not occupied by specially large or small corallites; calices sub-polygonal, the walls thickened at the mouths, the larger calices completely surrounded by smaller ones in a single row and often isolating the large ones; variable in size and shape; both sets of corallites with complete, horizontal

tabulæ, more numerous in the smaller than in the larger ones; walls thickened toward the mouths and apparently fused with one another; larger corallites shown in cross sections to be oval or circular, and moderately thick-walled. (Prodr. de Palæont., 1850, p. 25; Nicholson, Genus Montic., 1881, p. 110.)

Locality.—Cincinnati and vicinity.

Remarks.—A common and variable species, easily distinguished by the conspicuous monticules and the great numbers of smaller tubes surrounding the larger ones. Two forms have been given varietal names as below:

Var. RUGOSA (Edwards & Haime), Nicholson, 1881.

Differs from the type in the surface having transverely elongated monticules, forming, in many cases, transverse ridges, these varying in length, sometimes extending round the stem, usually with sharp edges, and about one-half a line apart; calices and interstitial tubes as in the type; internal features the same as in the type form. (Brit. Foss. Cor., 1854, note on p. 265; Nicholson, Genus Montic., 1881, p. 113.)

Locality.—Cincinnati and vicinity.

Var. DALII (Edwards & Haime), Nicholson, 1881.

Differs from the type in the smaller-sized monticules, and smaller number of interstitial tubes; the monticules are gently rounded, or somewhat transversely elongated; internal structure is the same as in the type form. (Brit. Foss. Cor., 1854, p. 265; Nicholson, Genus Montic., 1881, p. 115.) (*Chætetes approximatus* Nicholson, Quart. Jour. Geol. Soc. Lond., vol. 30, 1874, p. 502. *Callopora subnodosa* Ulrich, Geol. Sur., Illinois, vol. 8, 1890, p. 417.)

Locality.—Cincinnati, Blanchester, etc., O.; Illinois.

Remarks.—Prof. Nicholson has recognized that his *Chætetes approximatus* is a synonym for this form. There can scarcely be a doubt but that *Callopora subnodosa* is also a synonym. The points of difference between the two are not sufficient to separate them.

36.— M. NODULOSA Nicholson, 1874.

Corallum minute, dendroid; stems varying from two-thirds of a line to one line in diameter, branching at intervals of two lines; surface with numerous conical or transversely elongated monticules; calices oval, the long axes corresponding with the long axis of the corallum, opening obliquely; walls thickened at the surface; interstitial corallites numerous, nearly enclosing the larger cells, angular or sub-angular; tabulæ comparatively few, but increasing in numbers toward the surface, always complete and approximately horizontal; more numerous and more closely set in the small than in the large corallites; in transverse sections the cells of the central region have thin walls and are angular in shape; in the other portions oval and with thicker walls; each corallite is surrounded by a distinct wall, the interspaces being occupied by a well-developed series of small, more or less angular, interstitial cells, variable in size; corallites nearly straight in the axial region. (Quart. Jour. Geol. Soc. Lond., vol. 30, 1874, p. 506; Genus Montic., 1881, p. 116.)

Locality.— Loveland, Ohio.

Remarks.— This species is distinguished by the small corallum, the sharply-pointed and closely-set monticules and the elongated calices.

37.— M. NEWPORTENSIS Ulrich, 1883.

Corallum sub-ramose, lobate, robust; surface covered with more or less prominent, rounded, often elongated monticules, the summits and slopes of these occupied by cells larger than the average; calices sub-circular or ovate, rather regularly arranged in intersecting series, sometimes surrounded by an elevated rim often inflected at the points occupied by the minute spiniform corallites; interstitial cells present, but not readily seen externally; longitudinal sections show two kinds of corallites, the larger with thin walls and a series of vesicles on one side, with straight tabulæ from the convex side to the opposite wall; the smaller corallites have crowded, horizontal tabulæ; tangential sections show thin-walled tubes with obscure indentations in the walls; interstitial tubes surround

the larger ones in one or two rows, and these are about one-half their size. (Jour. Cin. Soc. Nat. Hist., vol. 6, 1883, p. 250, as *Atactoporella newportensis.*)

Locality.— Newport, Ky.

38.— M. OHIOENSIS James, 1884.

Corallum dendroid, stem and branches mostly cylindrical or sub-cylindrical, sometimes flattened, sometimes tumid; branches irregular, generally dichotomous, varying in size from one and one-half lines to six lines wide, sometimes one and one-quarter inches across branches; surface with numerous conspicuous elevated monticules, arranged in alternate manner, one-half line in diameter at base and about the same distance apart; larger calices circular or sub-polygonal; the smaller round or angular, numerous; walls thicked at the mouths; corallites in the axial region with thin walls, polygonal and curving abruptly toward the surface; walls thickened and apparently fused together just outside the sharp curve; tabulæ in the axial region few or wanting, but toward the surface more numerous, complete and horizontal; interstitial tubes no more closely tabulate than the larger ones; in tangential section corallites rounded, the interstitial tubes varying in shape. (Jour. Cin. Soc. Nat. Hist., vol. 7, 1884, p. 137.)

Locality.—Cincinnati, O.

Remarks.—This species is well characterized by its robust form and the conspicuous monticules.

39.— M. WORTHENI James, 1882.

Corallum dendroid, of cylindrical or flattened stems, branching irregularly, from one to two lines in diameter; surface with small, prominent monticules, arranged in alternating, longitudinal rows about one line apart; apices apparently solid, the slopes occupied by cells of ordinary size or larger; calices sub-circular or angular, margins thick; no interstitial corallites; longitudinal sections show corallites with thin, simple, wavy or tortuous walls, thickening toward the surface and opening obliquely; no tabulæ in the axial

region, and but few in the outer zone; tangential sections show cells sub-oval or sub-circular, thick-walled, surrounded by an open space; there is some indication of spiniform corallites at the angles of some of the larger tubes. (The Paleontologist, No. 6, Sept. 12, 1882, p. 50.)

Locality.—Lynchburg, Highland County, etc., Ohio.

Remarks.—This species somewhat resembles *M. ramosa* var. *dalii*, but the interstitial tubes are absent.

40.—M. CRASSIMURALIS Ulrich (sp.), 1890.

Corallum dendroid, dividing at intervals of 10 to 18 mm.; branches with low, rounded monticules; apertures circular, arranged in regular curved series, about eight in 2 mm.; interspaces thick, flattened centrally, sloping down to the apertures and thickest on the monticules where a few illy-defined interstitial tubes are found; tangential sections varying, the interspaces sometimes with openings of varying form and size, or again filled by a deposit of a light color; walls in the axial region very thin; corallites regularly rhomboidal or pentagonal; tabulæ complete and horizontal, wanting in the axial and very few in the peripheral region; numerous and thick in the interspaces. (Geol. Sur. Illinois, vol. 8, 1890, p. 452, as *Monotrypella crassimuralis.*)

Locality.—Wilmington, Ills.

Remarks.—This species presents many points of resemblance to *M. wortheni*, but it seems best to arrange it provisionally as a distinct species. It has not been recorded from Ohio as yet.

[TO BE CONTINUED.]

NATURAL HISTORY NOTES FROM NORTH CAROLINA.

BY A. G. WETHERBY.

Number Two.

THE LAND SHELLS OF ROAN MOUNTAIN AND VICINITY, CONTINUED.

The foregoing nine species have been grouped, with others, under Mesodon (Rafinesque, 1831), but whether the group is to be regarded as a genus, subgenus, or section, the systematists have left us in doubt. Binney (Bull. U. S. Nat. Mus., No. 28, p. 295), calls it "a *genus* strictly North American," but on the same page, a little farther on, says, "Nothing has been published regarding the jaw and lingual dentition of the *subgenus*," etc., thus making the group both generic and subgeneric on the same page! In the farther discussion of this division, he again uses the term genus. This section has affinities with *Triodopsis* (Rafinesque, 1819,) on the one hand and with *Stenotrema* (Rafinesque, 1819,) on the other. As it is difficult to draw the lines which will separate many of the so-called species in these groups, so is it difficult to make any complete generic or subgeneric separation. The passage from TRIODOPSIS into MESODON on the one hand, through such forms as *subpalliata* and *appressa* into *dentiferus* and *roemeri*, and on the other through *monodon* and *germana* into *M. lawi*, *mobiliana* and *jejuna*, is so gradual and complete as to obliterate generic or subgeneric division predicated upon the shell alone.

Still less dependence can be placed on the characters of the jaw and lingual ribbon. So great is the difference of these organs, even in individuals of the same species, that the true wonder is how so much "systematic" work has been based upon them. The most hurried analysis of authors' results, as

published, when grouped and tabulated, must, it seems to me, even astonish the authors themselves.

Besides this, there is little written recognition of the fact that animals, of the same species, may vary as well as their shells. Indeed, variation in the form of the shell indicates and presupposes variation in that of the animal. This is not a statement needing proof, nor any open question for debate. The relations of the shell and the contained animal are such that this observation needs no demonstration. For instance, the writer has found three reversed shells, of as many species, in the course of his collecting. In every species the animal was reversed, as well as the shell. Variation in size is the most common case. This is always accompanied by like increase or diminution of the contained animal, and snails are no exception to the general law of nature. The thrifty and free-growing examples differ as much from the dwarfed and stunted ones of the same species as do shrubs and trees. This statement needs no elaboration, and this case is typical of all others under varietal laws, and every student ought to know and to appreciate the argument that goes with it. The animal makes the shell. Every variation of the latter indicates some variation of the former. Hence, the finding of small differences in the animals is no basis upon which to predicate species, and is no more an argument in favor of certain forms being "new species" than are slight differences in the shells themselves. Here, again, tabulated results, from late "Manuals" and "Monographs" will astonish nobody, I am confident, more than the authors themselves.

Again, in nearly-allied individuals, differences may arise from the dissection of alcoholics taken during the procreative season and out of it. I call the attention of the systematists who lay so much stress upon genital warts and bunions to this fact. If they will drop a *subpalliata* taken *in coitu* into alcohol, and another taken under ordinary conditions, they will find the genitalia of the two examples, examined after a lapse of time, to differ more than has been regarded as of systematic value by some of the ablest writers we have.

In many, perhaps in most cases, the systematic student knows little of the exact conditions under which his material was captured. It comes to the great museums from the four

quarters of the earth. Even let the collector be as reliable as he may, the bulk of his material has to be taken as he can get it. It reaches the student by mail and by freight, from near and from far, reliable and unreliable, and he must take it as it is or do without. The numerous figures of worn and imperfect types of "new species" abundantly attest the truth of these statements. In cases like that of *subpalliata* above cited, the systematist must be saved by the shell, and I believe that the shell characters are just as reliable, and even far more so than *any others* for classification work.

Now the shells, in great groups, grade together. There is no need of hair-splitting, defining and redefining. Too much systematizing is just as bad as none at all. It is an attempt to draw hard and fast lines where none exist; to place boundaries where there is no room for them, and to drive the free lance of nature into the artificial tournament of the systematist. These statements may have little value or much, according to the care with which the student of our shells seeks to verify them. Further along we may have occasion to revert to this subject, and to publish some of the tabulated results above referred to.

TRIODOPSIS (Rafinesque, 1819).

10. *T. fallax* Say. This shell occurs here somewhat sparingly, of very large size, and differing from the Cincinnati specimens, which are normal, in the following particulars. They average larger, the shell is less solid, the coloring is deeper, and they are more rugosely sculptured; the parts about the aperture are more contracted and incurved. They are very fine examples of the species.

11. *T. tridentata* Say. Specimens of this species from this locality are always small, not having half the cubic capacity of the types. They are very dark colored, with rose-tinted lip, and are very attractive specimens. The attention of Cincinnati collectors, now in the field, should be called to the differences between the typical specimens common in the forests about that city, and a very distinct variety found under the limestone shingle and *débris* on the hill-sides above Fulton and elsewhere. The latter form is lighter in color,

more depressed, and much smoother, having a polished appearance. There are also differences in the parts about the aperture. Many years ago the now eminent explorer and naturalist, Mr. Wm. Doherty, insisted upon having these differences recognized by at least a varietal name. The same treatment that has been accorded to many others of our land shells would make a distinct species of this form, and lately two or three of my correspondents have revived the suggestion of varietal designation for it. I leave this with the book makers.

I will add, also, that I have taken, at Braden Mt., in Campbell Co., Tenn., a still more aberrant variety. The shells are very large, very much depressed, deeply sculptured, with the denticles about the aperture little developed and remote. It occurs in this locality with *P. mordax* Shutt., *M. chilhowensis* Lewis, *M. wetherbyi* Bld. *typus*, a very small, deeply-sculptured, and much-flattened variety of *T. appressa*, and fine examples of very large specimens of *Z. sculptilis* Bld. The variations in form, size, sculpture and coloring of this common species are, it seems to me, very suggestive.

12. *T. rugeli* Shuttleworth. Two forms occur here. One is found in the damper portions of the forest and is smaller and less typically-developed about the aperture. The other, found sparingly on the drier granite ridges, is two or more times the cubic capacity of the first, and has the mouth parts normal to the species as described. This variety is rare, and the two grade into the following.

13. *T. inflecta* Say. This species is abundant here with no special variation from the type. In size it agrees with the smaller variety of the preceding.

The above four species are all that we have yet found here belonging to *Triodopsis*.

T. introferens Bld. has been found in neighboring counties South of us, and may yet turn up here.

STENOTREMA (Rafinesque, 1819).

14. *S. hirsutum* Say. This shell occurs here somewhat abundantly, in two forms; one is typical, much like the specimens found about Cincinnati. The other variety (*altispira*

Pils.) is confined, so far as our observations extend at present, to the more rocky portions of the forest, where it lives among the moss covering the huge granite bowlders, and among the *débris* collected in their crevices.

I sent this variety to the late Thomas Bland, in 1881, and he remarked upon certain differences in the aperture, and especially in the notch of the lip. The spire of this form is very much elevated, so that many specimens are quite entirely conical. They also vary somewhat in size, those from certain stations being nearly or quite as large in major diameter as the largest specimens of the following species.

15. *S. stenotremum* Férussac. This species is locally distributed here at various stations, but is not of general distribution like the preceding. It is of the normal type, the main variations being those of size only.

The above are all the species of *Stenotrema* that we have yet found here. *S. barbigerum* Redfield, found in counties below us, has not been found here. It may be found hereafter, as it belongs to our land-shell fauna.

Selenites (Fischer, 1878).

16. *S. concava*, Say. This species occurs here, and is of general distribution, being found, though sparingly, in all stations and at all altitudes, to the very highest summits of the mountains. The specimens from the middle elevations and damper parts of the forest are the larger, and are by far the finest examples of this species that I have ever seen. The great distinctness of this shell from all others associated with it is in striking contrast with the inter-relations of the groups above enumerated. The animal has the carnivorous habits of many *Zonites*, the shells of which immature specimens of this species resemble in texture. It is the sole representative of the group in the Eastern United States.

Limax (Linn).

17. *Limax campestris*, Binney. Common about fields, and exhibiting no varietal characters worthy of note. The only *Limax* found here.

VITRIZONITES (W. G. Binney, 1879).

18. *V. latissimus*, Lewis. This fine mollusk, one of the most interesting yet found in North America, is of general distribution throughout this region, occurring at all heights, and in all kinds of stations. In dry weather it rests on the ground, under leaves, with the foot expanded. It is an active species, moving even during sunny days in midwinter. The shell is corneous, flexible, tough, not easily broken, but easily indented when fresh. During the procreative period the anterior portion of the body becomes very much swollen, as do all the organs of the genitalia. Though I have closely observed this singular animal for several years, I have never detected it feeding, nor have I been able to get any clue to the character of its food. So far as I know no species of *Vitrina* proper has been found here, though my friend, Mr. W. G. Binney, has repeatedly urged that search be made for them. The species under consideration is easily reared in "snaileries" or Wardian cases, and is a beautiful and graceful addition to their families.

ZONITES (Montfort, 1810).

This group, with its divisions *Mesomphix* (Raf, 1819), *Hyalina* (Férussac, 1819), *Conulus* (Fitzinger, 1833), and *Gastrodonta* (Albers, 1850), is represented by some of the most interesting and beautiful shells that we have here.

Very much attention has been given the species of *Zonites*, both in this country and elsewhere, and much time and labor, and much study, and many published results; yet this section of North American snails is to-day in a far from satisfactory condition of classification. It is not our purpose to add to this literature. That is for those whose mission, it seems, is rather to endeavor to improve nature than to interpret her.

19. *Z. capnodes*, W. G. Binn. Shells taken here by us, and also in Union County, Tennessee, were referred by Mr. Bland to this species. A careful dissection of the animals, and the closest study that we have been able to give them, show none of the differences pointed out by Mr. Binney. We therefore believe that all the shells so referred belong to

the next species, and that, so far as our local list is concerned, this species must be eliminated. Knowing the care and accuracy of Mr. Binney's work, we feel justified in setting this shell aside as one not found here.

20. *Z. fuliginosus*, Griffith. This fine species is obtained here, though somewhat sparingly. It occurs at various elevations, up to 4000 feet or a little more. Its habit is the same as that of No. 18, preferring a thin covering of leaves, with the foot spread upon the ground in dry weather. The *Zonites* are far more active than the other shells in cold weather, and this species is no exception to the rule. The eggs are deposited in agglutinated masses among the leaves, and many of them are devoured by the multitude of *gularis* and *cuspidatus* found with them. This accounts, without a doubt, for the comparative rarity of the larger species of *Zonites* here. The eggs and the young are devoured by these highly carnivorous and rapacious smaller species, whose peculiar shells protect them in a large measure from others of like habit, and from themselves as well.

21. *Z. lævigatus* Pfr. Same stations and same distribution as the last. This is a very variable species in color, texture, and sculpture. I have collected it in Ohio, Kentucky, Tennessee, North Carolina, Texas, Georgia, Alabama, Mississippi, and Florida. The most aberrant forms were in Rutherford Co., Tenn., and at Ellijay, Ga. The former was as thin and pellucid as *Vitrina limpida*, the shells being extremely fragile and delicate. They were much flattened and the umbilical opening was much larger than in typical *lævigatus*. Not thinking at the time that this shell could be the species in question, I gave it the manuscript name *Z. perfragilis Nov. Sp.* Unfortunately these shells were lost or misplaced and I have not been able to find them. The other variety from Ellijay, I was for a long time disposed to refer to *Z. caducus* Pfr., but I am now satisfied that they are, as determined by Mr. Bland, a rare form of this species. Very large and fine specimens, of the typical color and sculpture, were taken at High Bridge, on the Cincinnati Southern Railroad, in Mercer Co., Ky. A full set of the varieties of this species, from the various States in which it occurs, makes a beautiful, interesting, and highly suggestive addition to any cabinet of our land shells.

22. *Z. demissus* Binney. The true *demissus* is not uncommon here. Mr. W. G. Binney, in Bulletin 28, before cited, gives a very careful enumeration of the characters common to this species and *Z. ligerus*. The student who reads the technical descriptions prefacing his general remarks on these species, will find them practically alike, save in the number of whorls. The group of shells composed of *demissus*, *ligerus*, *acerrus*, and one or two forms that I have so far been unable to refer to either, is a very closely-allied one, and if the view of Mr. Binney is correct, and *acerrus* is but a large variety of *demissus*, it leaves the alliance still more pronounced. I have collected the typical *demissus* in Ohio, Kentucky, Tennessee, North Carolina, Texas, and Florida. It is rare in Ohio and the latter State. The most constant difference between this shell and *ligerus* is its more solid texture, and the thickening on the last half or one-third of the base of the body whorl. This is often quite entirely wanting in *ligerus*. The second difference is in the greater average depression of the spire in *demissus*.

An infallible test by which the collector who gathers and cleans his own specimens may be guided, is the peculiar aroma of *ligerus* when dropped into hot water. I have never cleaned a living shell of this species, from any locality, that failed to thus personate itself. It is so pronounced and so constant that it is curious this characteristic has not been noticed by writers.

As the writer of this article is making a special study of the variations of the *Zonites* group, he will be most happy to correspond with other collectors of them in any part of the United States, and to exchange notes and specimens. This genus, if such it is, presents the problem of variation in its best form, and furnishes abundant material. As the true object of the collector should be to make his cabinet as instructive as possible, the readiest method of attaining this end is to accumulate authentically located varieties of recognized species, and large series of the same species, for thus only can this object be accomplished. A collection of finely-prepared specimens, so arranged, is now as rare as it is valuable. The collector has been too often like the book-maker, led on by the fine rage for "species." It is time the more philosophical and reasonable method should predominate.

EXPLANATION OF PLATE XI.

Fig. 25.—Sectional view of the capillitium and stipe of Clastoderma De Baryanum, Blytt.

Fig. 26.—Section through the capillitium, columella and stipe of Lamproderma arcyrionema, Rost.

Fig. 27.—Perpendicular section through Lamproderma violaceum, Fr.

Fig. 28.—Perpendicular section through Lamproderma scintillans, Berk.

Fig. 29.—Section through the capillitium, columella and stipe of Comatricha Ellisii, Morgan.

Fig. 30.—Sectional view through the capillitium and columella of a portion of Comatricha crypta, Schw.

Fig. 31.—Sectional view through the columella and capillitium of a portion of Comatricha longa, Peck.

Fig. 32.—A portion of the capillitium of Stemonitis tenerrima, B. & C.—A sectional view through the columella above and below a view of the superficial network.

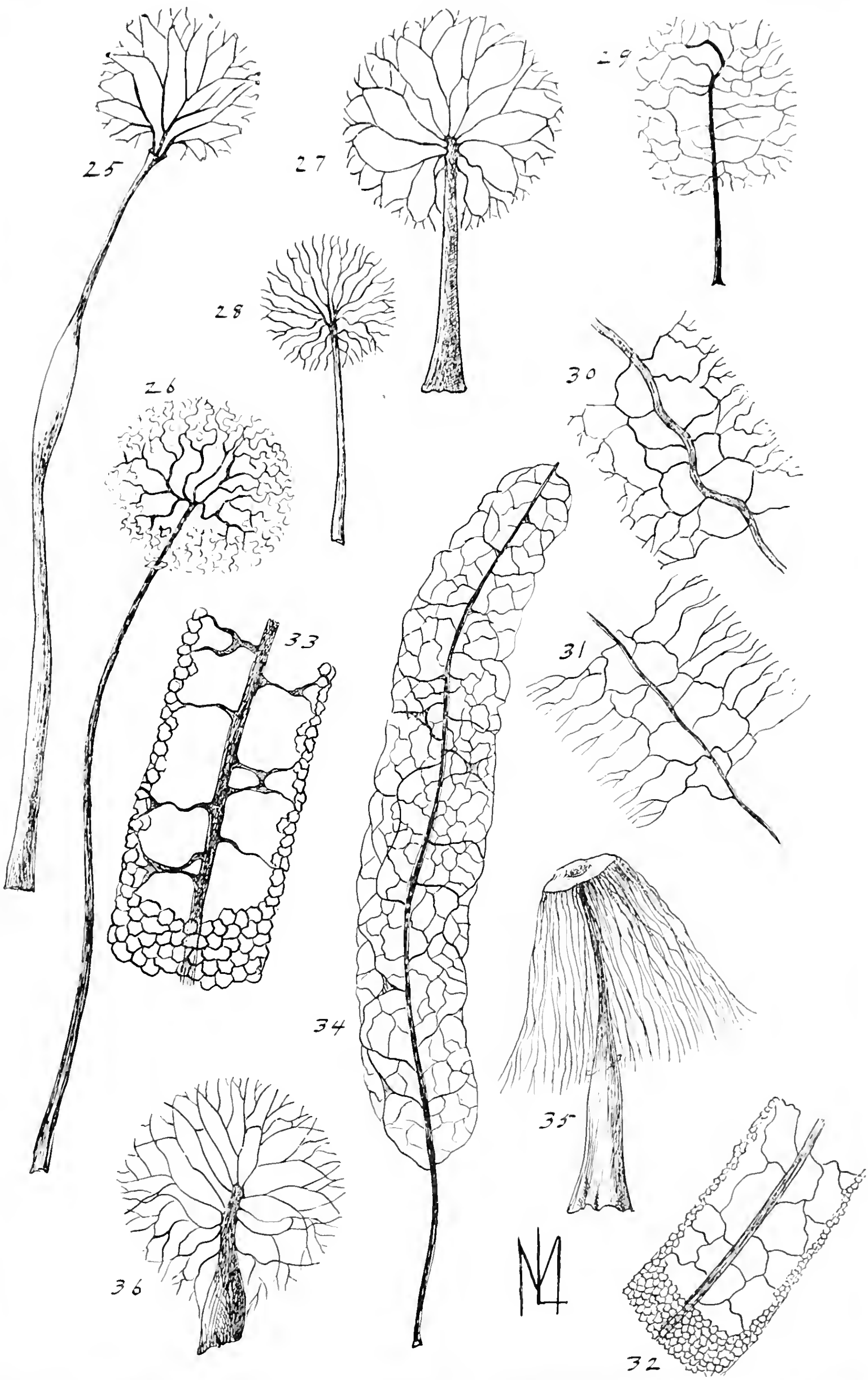
Fig. 33.—A portion of the capillitium of Stemonitis splendens, Rost.—A sectional view through the columella above and below a view of the superficial network.

Fig. 34.—The capillitium of a very short sporangium of Stemonitis Webberi, Rex; the breadth, however, somewhat exaggerated.

Fig. 35.—Showing the stipe, columella, apical disk and pendent capillitium of Enerthenema papillatum, Pers.

Fig. 36.—Perpendicular section through the capillitium, columella, and stipe of Diachaea Thomasii, Rex.

NOTE.—The figures of the objects are drawn as they appear under a magnifying power of about 100 diameters.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EXPLANATION OF PLATE XII.

37.—Didymium proximum, B. & C. *a.* Sporangium and stipe × 33. *b.* Section through the columella.

38.—Didymium eximium, Peck. *a.* Showing the rough columella of one form. *b.* Section through the discoid columella of the very much depressed form. Magnified by 33.

39.—Didymium minus, Lister. *a.* Sporangium and stipe × 33. *b. c. d.* Sections through the columella showing different forms.

40.—Didymium farinaceum, Schr. Section through the columella. After Rostafinski.

41.—Didymium anellus, Morgan. *a.* Growing upon a leaf × 3. *b.* Plasmodiocarp × 17.

42.—Spumaria alba, Bull. Var. 1. didymium, sporangia × 3. Drawn from a foreign specimen.

43.—Spumaria alba, Bull. *a.* Æthalium natural size. *b.* Capillitium and spores as seen by a magnifying power of 500 diameters.

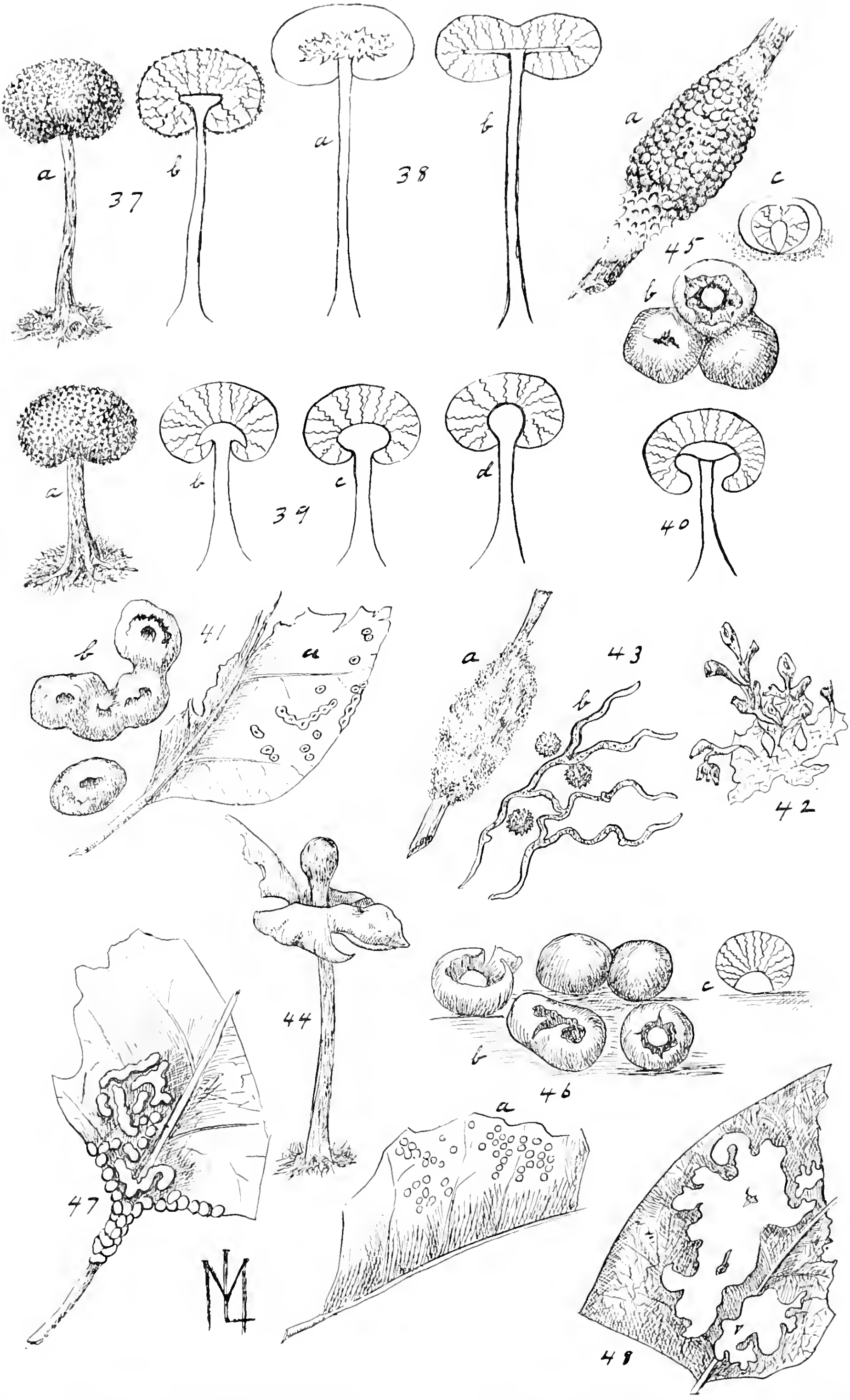
44.—Diderma floriforme, Bull. Stipe and columella × 20.

45.—Diderma crustaceum, Peck. *a.* Sporangia crowded on the thick hypothallus, natural size. *b.* Sporangia × 11. *c.* Section through outer coat, inner membrane, and columella.

46.—Diderma cinereum, Morgan. *a.* Sporangia growing on a leaf × 3. *b.* Sporangia × 23. *c.* Section through the wall and columella.

47.—Diderma reticulatum, Rost. Plasmodiocarp growing on leaf × 3.

48.—Diderma effusum, Schw. Plasmodiocarp effused on a leaf × 3.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Regular Meeting of the Society,
First Tuesday of each month, 8 P. M.

Executive Board Meeting,
Third Tuesday of each month, 3 P. M.

Photographic Section meets
Second and Fourth Mondays, 8 P. M.

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First Tuesday of each month, 8 P. M.

Executive Board Meeting,
First Tuesday of each month, 7 P. M.

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SETH HAYES.

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